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VOLUME 2

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REHABILITATION OF THE ARM AMPUTEE[1]

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During the four years of World War II, 17,000 servicemen lost their limbs as a result of war wounds and operational injuries. During the same period 120,000 civilians lost their limbs from accidental injuries and disease. Of both groups approximately a third were arm amputees. On the selection of proper prosthesis rested the future of most of these men.

Selection and procurement of prosthesis is only one step in an integrated program of rehabilitation that was developed for the military casualties. This program has not been made available for civilian cases. Such a program includes the psychological preparation of the patient, adequate surgery to provide a stump which will permit the patient to wear a satisfactory prosthesis without pain and with comfort and utility, the after care of the stump which will reduce the sensitiveness of the stump, the selection of the prosthesis and the training of the individual in the use of his prosthesis. We cannot discuss all the procedures required to provide the amputee with a complete and integrated program of rehabilitation. For this discussion we will concern ourselves only with the selection of prosthesis and training.

There are two primary requirements that a prosthesis must fulfill if it is to meet the needs of an arm amputee, that of dress and that of utility for the routine pursuits of life. To date there has been no one prosthetic device that has been able to satsify these requirements.

There are many reasons why arm prostheses are the least satisfactory of all prosthetic appliances. It is easy to duplicate the function that has been lost in the lower extremity since weight bearing and locomotion can be easily reproduced. In the upper extremity, however, the functions are so intricate and complex that they cannot be duplicated, they can only be imitated. Furthermore the one function which the amputee misses above all else is tactile sensation. This function has not yet been replaced by the inventive mechanical genius of the engineer. Then again, compensation comes into play, so that the one armed person finds that even without prosthesis he can carry out his daily needs. Even the bilateral amputee may prefer to get along without prosthesis. Finally, the prosthesis is a poor substitute in providing the individual with normal appearance. Yet it is important that the physically handicapped person appear normal since he is faced by the severe prejudice of the public toward all the disabled. By camouflaging his defect he overcomes the truculent attitude of the man in the street, the employer and his fellow worker.

Is there any prosthesis that can meet all these demands of function and appearance? Obviously, no. What then are the devices that are available and which ones shall we select for our patients?

[1] Presented at the Fifteenth Annual Meeting of the American Society of Plastic and Reconstructive Surgery, Kansas City, Mo., November 14, 1946.

There is of course the dress arm. This is the most common type of appliance in use. In a survey of 9,000 arm amputations in Germany, 60 per cent preferred the arm for dress alone Made of wood, leather, plastic, latex or felt, it can be made comparatively light and even in some cases sufficiently artistic to duplicate the natural appearance of the normal hand. However, the duplicity is quickly discovered The lifelessness soon gives the wearer away so that the camouflage is rarely perfect. Nevertheless, it is satisfactory in providing a fairly normal appearance. Who shall wear them? Women, especially; men too, but the determination must be made on a survey of the individual, his attitudes, needs and personality

For a woman 65 years of age with a forearm amputation following a compound fracture and osteomyelitis, it would be a serious mistake to provide her with a

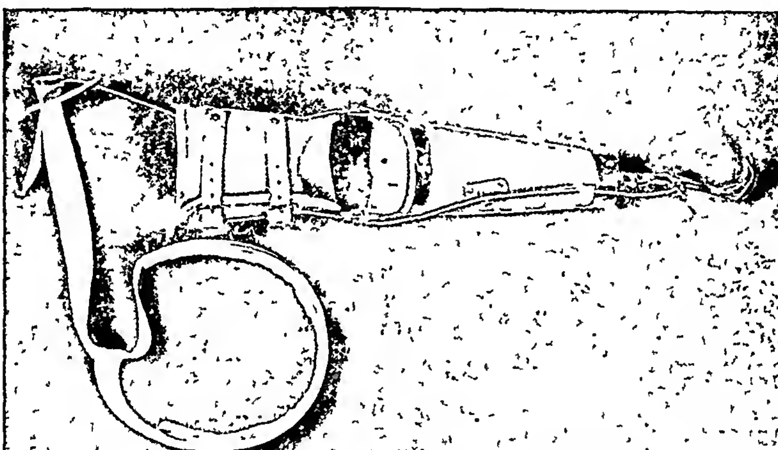

FIG 1 STANDARD TYPE OF PROVISIONAL UTILITY HOOK APPLIANCE

heavy mechanical arm. A simple dress arm with a spring thumb for simple acts of prehension is sufficient.

But if the patient desires an increased range of useful functions, the device should be able to accomplish at least a few simple hand functions It is impossible to duplicate the permutations and combinations of hand and finger function. However, there are four simple functions which are important and can be duplicated mechanically They are forceps action, pliers action, ring action and hook action. These functions can be obtained by the standard type of utility hook which is held closed by a heavy rubber band and opened by the action of a loop around the opposite shoulder which pulls on a lanyard attached to an outrigger on the hook. Closure of the hook is accomplished by the simple release of the pull on the lanyard, the hook closing by the action of the elastic band. While the amputee can exercise considerable ability in the handling of routine tasks the hook does not hold soft objects satisfactorily like a cigarette or

FIG. 2. BILATERAL ARM AMPUTEE WITH UTILITY HOOKS

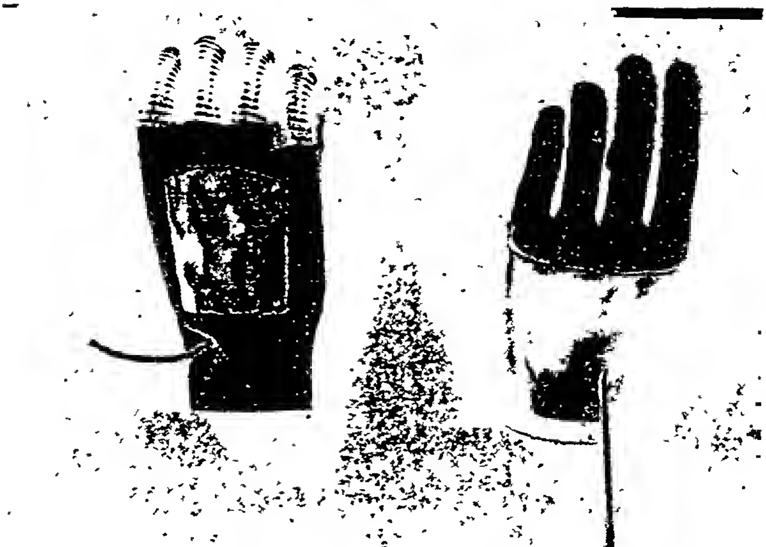

FIG. 3. INTERCHANGEABLE DRESS AND MECHANICAL HANDS FOR UTILITY APPLIANCE

a doughnut. The ability to control the exact amount of force exercised by the open hook has been called selective pressure and is a function that only a few amputees can obtain with the split utility hook. Furthermore there is still the question of appearance. In the amputation center and in the hospital area while segregated with other amputees he is not exposed to public prejudice. When he returns home and finds himself one of a few in the community, dress and appearance then become a serious matter. In this case he can remove his hook and apply a dress hand or a mechanical hand (Fig. 1, 2, 3).

The fitting of a prosthesis to an arm amputee differs from that of the leg

FIG. 4. ARTICULATED MECHANICAL ARMS IN BILATERAL AMPUTEE

amputee in that there is less opportunity for standardization. In the leg the prosthesis is fitted to the patient's stump. In the upper extremity the prosthesis is fitted to the patient's personality. His hopes, aspirations and background must be taken into consideration in deciding on the prosthesis. Certainly it would be a mistake to furnish a lawyer with a hook prosthesis to wave in the court room, or a bank teller to handle money across the teller's cage or a Fourth of July orator as he admonishes his audience with his prosthesis. We must search further for our selection.

Mechanical arms have had a popular vogue in this country and abroad in that the hand provides some of the fundamental hand functions and provides at

Fig. 5A. Cineplastic hand for forearm amputation

Fig 5B Cineplastic prosthesis for upper arm amputee

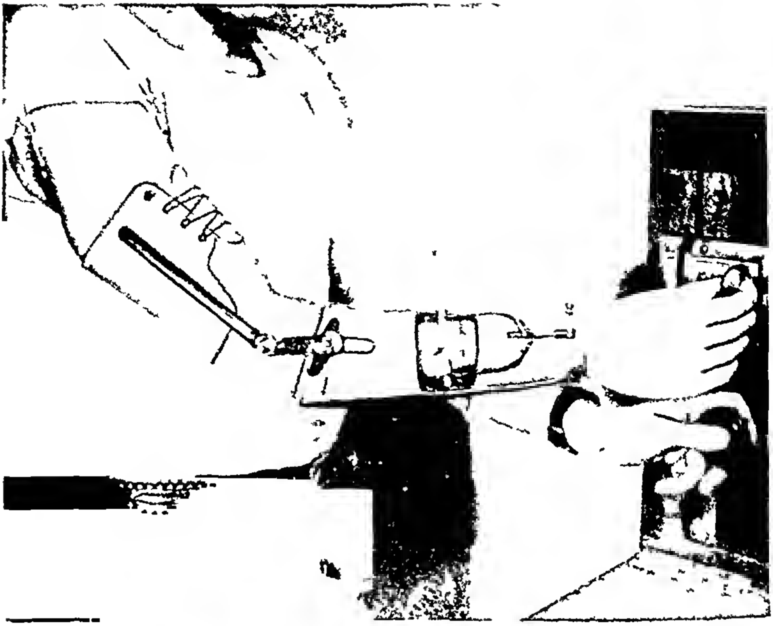

Fig. 6A With cineplastic hand light routine activities can be carried out

Fig 6B Even heavy work in a steel plant can be performed by this bilateral amputee with cineplastic prosthesis

Fig. 7. Utility Appliance Operated by Cineplastic Motors

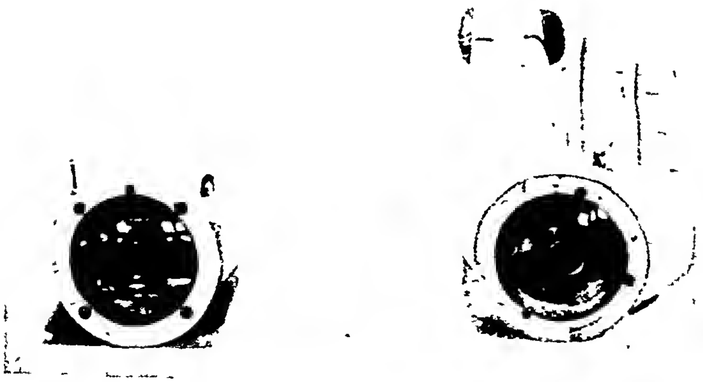

Fig. 8. Interchangeable Utility Appliance and Cineplastic Hand

the same time a fairly satisfactory resemblance to the natural hand sufficient to satisfy ordinary requirements for dress and appearance. However there have been mechanical difficulties and weight problems that have limited their usefulness. When a limb of this sort requires a great deal of service in the factory or shop the amputee soon discards it (fig. 4).

Another method available to the amputee is cineplasty. The muscles that remain in the stump are canalized and attached to a system of levers so that the flexors and extensors in the forearm and the biceps and triceps in the upper arm activate the artificial hand and arm (fig. 5). The great advantage of this method is the natural and physiological action, the simplicity of the mechanical device,

FIG. 9. BLIND BILATERAL ARM AMPUTEE WITH KRUKENBERG AMPUTATION

the effortless control and the avoidance of straps, loops and harness to the opposite shoulder for below elbow arms. But the principle had its limitations in applying it to the needs of factory workers, farmers and laborers who required a prosthesis that could exercise considerable force. Although a few users of cineplastic apparatus have engaged in hard manual work it has generally been accepted for the use of the white collar class and those in light industrial pursuits (fig. 6).

The scope of cineplasty can now be extended to more varied and energetic physical demands through the development of a utility hook operated by cineplastic motors and interchangeable with a cineplastic hand. This has been

accomplished by the development of an ingenious spring coupling which permits interchangeable action of the hand and hook by the cineplastic motors. Thus the cineplastic amputee can use his motors for work and his hand for appearance (figs. 7, 8).

In addition to cineplasty other special methods are available to the amputee to meet his special needs. The Krukenburg operation is one of these methods. It consists in the splitting of the forearm into two fingers so that the approximation of the two digits provides prehension while the natural skin innervation permits normal tactile sensation. The method has been very popular in Germany and Russia. In the United States where considerable professional as well as public prejudice exists toward the appearance of the latter there has been a natural reluctance to undertake this measure. Yet it is a valuable procedure for the bilateral amputee since he requires no prosthesis. It is of especial value for the blind bilateral arm amputee (fig. 9).

Thus we see that there is no single idea or miracle prosthesis that will solve the problem of every amputee. It is a mistake therefore to adhere slavishly to one device alone. For the amputee there must be made available a large variety of devices and methods which can be fitted to meet the special needs of the patient. This is the function of the physician or surgeon who is concerned with the rehabilitation of the amputee.

It is not enough however to select the proper device for the patient. Unless he is given adequate training in its use he will discard it for a variety of reasons. The advantage of training was especially seen in the service amputation centers. At these stations intensive programs of physical conditioning and active training were undertaken in the use of the appliance for the routine pursuits of life.

In the rehabilitation of the arm amputee a five point program is required, the psychological preparation of the patient, the selection of adequate surgical methods which will give him a painless and satisfactory stump, the after care of stump, the selection of a device or special surgical procedure which will permit him to wear a prosthesis and finally the training of the amputee in the use of the prosthesis. By this means the military and civilian amputees can take their place in commercial and industrial life in competition with those who are not physically handicapped. Fortified with the special skills acquired by proper training they face the future with possibilities unlimited.

TUBED PEDICLE COMPLICATIONS IN REPAIR OF MASSIVE TISSUE DEFECTS

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Massive tissue loss in battle casualties has made the plastic surgeon cognizant of practically every complication encountered in the use of the tubed pedicle graft. In the hands of skilled and experienced men, despite great care, complications still do occur. We shall present the main points in the formation of tubed pedicles and, with the aid of drawings and photographs, describe the pitfalls.

The tubed pedicle, by its network of blood vessels in the subcutaneous layer, provides an excellent medium for filling large defects. The principles of massive tissue movement are the same in all flap transfers. Several factors must be remembered: (1) The main blood supply to skin and subcutaneous tissue comes from vessels in the deep fat. These usually course just above the deep fascia, with branches going upward to form an anastomosis beneath the dermis. Another layer of network can be found just under the Malpighian layer (fig. 1). It becomes apparent from this principle that all massive tissue movements must contain all the fat to the deep fascia if the blood vessels are to be included for nutrition. (2) Any abnormal tension on a flap of tissue will lead to a necrosis of the skin or deep layers. Tension serves to stretch the elastic fibrils in the skin and constrict the vessels, causing death of the tissue. (3) The principles of "delaying" a flap must be understood. A delay is used to enhance circulation to a flap by gradually cutting its nutrition from all sides but the pedicle to which it is attached. The safest way to delay a flap attached to a tube is to perform the procedures in at least two stages. These are known as primary and secondary delays. The primary delay consists of two parallel incisions from the end of the tube along three-fourths of the desired flap. The entire flap is undermined along the deep fascia layer. The secondary delay consists of connecting the two lines made in the primary delay by an incision through the skin and subcutaneous tissue to the deep fascia layer. If there is any doubt about the circulation, a tertiary delay is done. This consists of re-elevating the entire flap up to the base of the tube and resuturing it in its previous position (figs. 2A and B). The entire plan of delaying is analogous to root pruning a tree before transplanting it. Microscopic evidence shows that veins and arteries change from irregular directions to parallel lines through the pedicle into the flap, with a great increase in size. (4) The graft is dependent upon a delicate blood supply; therefore,

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gentle handling of the tissue is essential. Rough manipulation causes thrombosis of blood vessels. The skin itself is never held with a forceps. Blunt dissection with fingers or scissors is never used to separate layers. Hooks are excellent to hold tissue. Raw surfaces must not be left uncovered unnecessarily without moisture. Tissue holding by hands should be limited to absolute necessity.

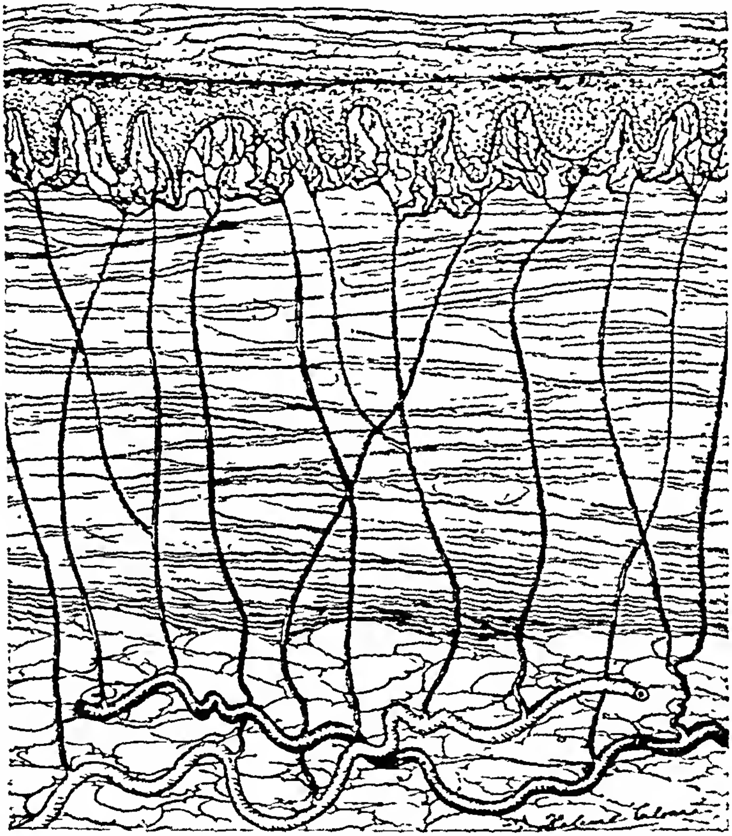

FIG. 1. DIAGRAM ILLUSTRATING COURSE OF BLOOD VESSELS IN THE FAT AND SUBCUTANEOUS TISSUE

It is obvious that unless all fat is included in a flap, the danger of cutting across large vessels is present. All fat layers should be included in massive transfers

(5) The flap obtains its nutrition through the tube. The greatest care must be exercised at all times to keep the tube free from compression, torsion, or pressure, any of which will jeopardize the blood supply.

FORMATION OF THE TUBE

The tubed pedicle graft, known as the Filatov or Gillies tube, is a means of transferring tissue from one part of the body to another. The advantage of

tubing a flap is that it increases the number of smaller blood vessels and their ramifications so that the tissue involved may be transferred with less peril This tubing also provides for closure of all denuded surfaces Whether the tube

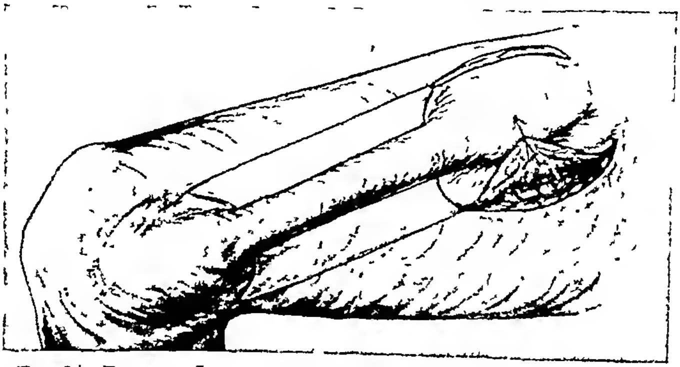

FIG 2A DIAGRAM ILLUSTRATING PRIMARY DELAY OF PEDICLE FLAP

Note incisions running from heel of pedicle ¾ths length of flap Note parallel incisions and undermining from these incisions under the *entire* flap.

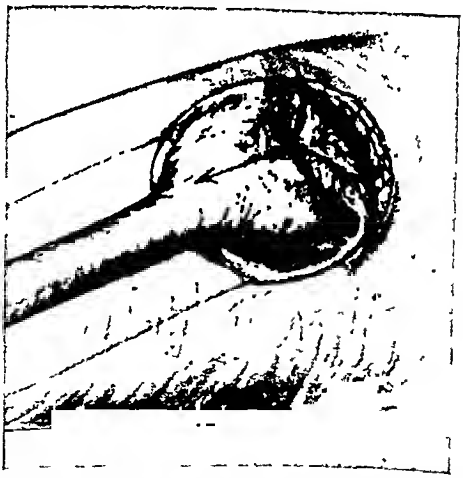

FIG 2B THE SECONDARY DELAY IS AN INCISION CONNECTING THE LINES MADE IN THE PRIMARY DELAY

There is no need for any further undermining since *all undermining* was done at the primary delay

is made on the arm, neck, chest or thigh, the principles of formation are the same and the complications are similar.

The standard method of making a tubed pedicle has been to raise a flap of tissue attached by a pedicle on each end and tubing the flap. The defect left

by raising the flap is closed by undermining and suturing. The most common trouble has been the breakdown of tissue at the angles of the tube, caused by the extensive undermining and tension on sutures. To avoid this difficulty, split skin grafts have been laid over the donor defect. Thus, extensive undermining beneath the ends of the tube and at the lateral sides of the donor defect was avoided, and breakdown of the angles became rare. Nevertheless, complications still occur, and we shall describe and illustrate those we have encountered.

COMPLICATIONS OF THE TUBE

1. Necrosis along the suture line of a tube exposing fat (fig. 3). Perhaps all necrosis along the line of suture and tube reopening can be traced to tension. Too much fat is included in the tube, or conversely, the tube is insufficient in width. The safest way to avoid this complication is to mark out the prospective tube flap on the skin with methylene blue. Only one incision is made at first. The flap is undermined completely from this one incision, dissection being with a sharp knife along the fascial plane. All bleeders are carefully caught. When the undermining reaches the line previously marked on the skin, an attempt is made to fold the skin under as if to tube it. At this point, one can visualize whether or not there is sufficient laxity to allow easy tubing (fig. 4). A fat person requires a wider flap. On the neck the average width is 5 cm., on the chest 10 cm., while the thigh most often requires 12 to 14 cm. We do not feel that fat should be cut from the flap in order to more easily form a tube. This disturbs numerous small vessels. When the epithelium becomes necrotic and the tube separates, sloughing continues until all tension is gone. This causes a thrombosis of the remaining vessels and the tube is worthless. We feel that suturing a tube with #B silk for skin only is adequate. The need for subcutaneous sutures or heavier skin silks is indicative of too much tension. Should the tube be too tight, despite all the precautions taken, it is advisable to employ a split skin graft on the under surface of the flap, as well as the donor site, instead of trying to make the tube.

2. Hemorrhage in the tube. Great care must be exercised in obtaining complete hemostasis. Hemorrhage in the tube will cause compression of the vessels, resulting in strangulation. Even a mild hemorrhage will cause extra scar, which will interfere with circulation. If, after the operation is completed, one feels that there is bleeding into the tube, it should be re-opened and the bleeder tied.

3. Necrosis in the center of the tube. Any tube which crosses the midline (neck excepted) will show signs of embarrassed circulation, with probable loss of the center of the tube. To make this procedure successful, the portion in the midline must be delayed and later tubed. If possible, it is far better to refrain from crossing the midline because of the inadequate circulation in this area. Disproportion between width and length will also cause a central loss.

4. Excessively long tube. A very long tube is useful in moving tissue long distances without intermediate stop-overs in the migration. However, the length must be balanced by adequate width to insure adequate blood supply at the center of the tube. Embarrassed circulation, without necrosis, may cause a

FIG. 3 THE RESULTS OF EXCESSIVE TENSION IN MAKING OF A TUBE

The width of the flap was 12 cms, about the average width for most tubes However, there was a considerable amount of underlying fat which necessitated even greater width.

loss of the distal tube and flap on transfer. A questionable tube must have several delays of its distal end before transfer. Figure 5 describes the death of

Fig. 4. Illustration of Folding of Skin Flap to see if it Will Tube Easily

This must be done the *entire length* of the tube, since folding at the corners diminishes the length of the free tube. The easy folding must be present along the entire desired free length.

Fig. 5. Resultant Necrosis of Thoraco-Abdominal Flap Caused by an Excessively Long Tube

This tube extended from the axilla to the pubis. It was made in one stage. The first evidence of poor circulation was a thinning of the tube and central necrosis. This was of a minor degree, however, and the tube was considered adequate to transfer after three delays. Twenty hours after transfer to a defect on the arm, the flap was white and then went on to necrosis. A goodly portion of the fat remained viable however. It will eventually be covered over with a split skin graft and the tube will be transferred up to cover the defect.

a flap attached to a long tube. This can be eliminated by the use of a central bridge and tubing later. The presence of a bridge adds small vessels to the center of the tube.

5. Excessively short tube. A short tube to reach its destination must be moved numerous times Each procedure carries with it an added risk.

6. Poor location of tube. A knowledge of surface circulation is essential in placing a tube. Full use of all blood vessels is absolutely necessary.

7. Excessively large flap for size of tube. In using a flap at the end of the

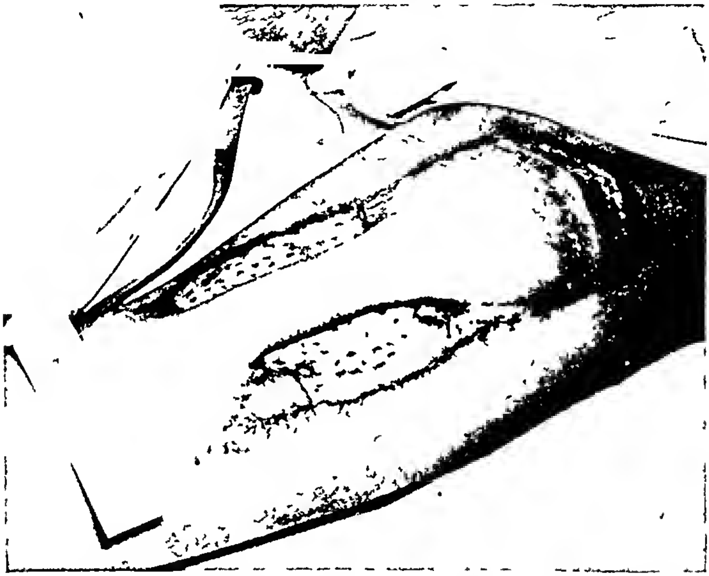

FIG 6. PHOTOGRAPHS OF THE RESULTS OF IMPROPER SECONDARY DELAY

The flap had been lifted for transfer to a foot defect Several large vessels were found to enter the flap just distal to the superior border These were tied and cut Transfer was considered unsafe Flap was then resutured to its bed Despite this precaution, about 2 cms of the superior margin of the tip necrotized A proper secondary delay would have cut these vessels and forced circulation from below.

tube, the vital width-length ratio must be borne in mind. Any question of this ratio calls for further delaying of the flap.

8. Infection. This is self-evident Any infection tends to thrombose vessels and imperil massive tissue transfer.

COMPLICATIONS OF DELAYS

1. Completion of delay in one stage with resulting necrosis of the tip. To lift a large tube flap from its bed in one stage will cause a possible loss of the flap. The technic of delay must be followed (fig 2).

2. Excessive undermining and excessively long incisions in a planned primary

delay. In a planned primary delay of a flap, bilateral incisions are made from the base of the tube about three-fourths of the length of the desired flap. To make these incisions longer with the routine undermining of the flap, may jeopardize the circulation (fig. 2B).

3. Edge necrosis due to tight sutures. This complication is most noted when combined skin and subcutaneous sutures are used, with extensive amounts of fat included in the suture.

4. Infection. The results of infection are again self-evident; any type of necrosis from minor to major degree can develop.

5. Failure to undermine adequately. In the primary delay, one must undermine the entire planned flap through the incisions described. Failure to complete the undermining with severance of all perforating vessels will make the secondary delay worthless.

FIG. 7. PHOTOGRAPH SHOWING DANGEROUS KINK IN TUBE AT ITS ORIGIN

The flap survived despite this kink. The ideal situation calls for a direct line from the donor to the recipient site, avoiding any possible circulatory disturbance

6. Hemorrhage. Hemorrhage is common. The parallel incisions often provide inadequate vision of the area, but all bleeders must be located and tied. Too much care cannot be exercised.

COMPLICATIONS OF SECONDARY DELAYS

The secondary delay is merely an incision through the distal end of the flap, uniting the primary delay incisions. Aside from infection and hemorrhage,

complications are rare. In this delay, all long vessels coming into the distal end of the flap are ligated. (Fig. 6 shows necrosis resulting from failure to do a proper delay.)

COMPLICATIONS OF TERTIARY DELAYS

In doing this procedure, one lifts the distal end of the flap slowly and gradually undermines up to the base, looking for any blanching. At any point up to the tube, should the color change, one must return the flap at once, with no tension. Aside from the possibility of infection and hemorrhage, complications are few.

Fig. 8. Photographs Illustrate the Types of Holes to be Filled with our Flaps

Bone chips from the ilium were used to fill the defect at the time of the transfer of the flap to the leg. Twenty-four hours later, the flap became markedly cyanotic over the bone filled area, and then went on to necrosis of all the flap which covered the bone chips. Enough of the flap had been attached to soft tissue to allow adequate circulation to the distal end of the tube. After six weeks, the distal end was detached from the thigh and sutured just above the defect on the leg. One month or so later, the tube will be opened, now having circulation through two ends, and will be laid over the hole.

COMPLICATIONS OF TRANSFER OF TUBE AND FLAP

This procedure requires great care. The flap is lifted from the donor site and both the tube and flap carefully observed. Any blanching is a signal for return. The complications are many:

1. Inadequate circulation through the tube. Arterial changes may be noted at once by blanching. Poor venous return can be noted early by bluish discoloration. To facilitate venous return, it is best to have the recipient site at a higher level than the donor. A proper tube should have adequate circulation.

2. Tension in suturing flap. *The flap must fill the defect.* It cannot, however, be stretched in any way. Normal skin tension is necessary to prevent kinking of the vessels.

3. Kinking of the tube. Any twist, kink, or angulation of the tube will interfere with circulation and cause necrosis. The amount of circulatory instability

is of course undeterminable. Regardless of the position of the patient, the tube should have no kinks (fig. 9).

4. Covering holes with or without bone chips. We have had several flaps placed over holes in tibias, bone chips having been placed in the defects at the time of operation. Three of these flaps showed marked hemorrhagic reaction, with necrosis (fig. 8). In those cases where the flap was placed over a hole without a filler, hemorrhage was a common occurrence, necessitating evacuation of the blood clots. To insure the best results the flap should contact a good recipient bed. Temporary drains prevent hematoma formation.

FIG. 9. ILLUSTRATION OF THE EFFECTS OF HEMORRHAGE UNDER THE FLAP

This pedicle had been placed over a hole where no bone chips had been placed. Hemorrhage filled the area. The drain used had been inadequate. The flap went on to partial necrosis of the distal portion.

5. Excessive pressure on flaps. To prevent hemorrhage and edema, pressure is placed on the flap; however, too much pressure will cut the circulation at the base of the flap.

6. Angulation of the flap. A flap having apparent adequate circulation will develop necrosis distal to a point where there is pressure, such as is encountered in rounding a corner or extending over a ridge.

7. Use of inadequate flap for transfer. In transferring a tube flap from the chest to the leg, with the hand as a carrier, the flap attached to the dorsum of the hand should be the same size as the flap which will be placed eventually on the leg. It is very difficult to transfer a greater amount of tissue. Many tubes

have come to our hospital with only the ends attached to the hand or wrist. They could scarcely support the tube.

8. Inadequate cast for fixation. In leg cases, a firm hip spica cast must be used to prevent motion and maintain the correct fixation.

9. Heat burns on flaps. We have had two cases where burns of the flaps have occurred due to focal beam heat from portable lights.

CONCLUSIONS

We have listed the complications we have found in making and transferring tubes. In the hands of the best surgeons, complications will occur. We hope that by pointing out the troubles we have witnessed, others will be aware of the dangers and will be prepared to recognize and handle them. More than three hundred tubes have been made at the Army general hospital in which these cases were seen. Despite various minor erosions, all but two transfers were completed. One point bears reiterating—gentle handling of tissue is essential.

SURGICAL TECHNIQUE HELPFUL IN OBTAINING FINE SCARS[1]

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To obtain as inconspicuous a scar as possible has always been one of the chief objectives of the plastic surgeon. When tissues are once severed, either by the scalpel or by trauma, the natural healing process calls for scar formation. Our problem is to control the amount of scarring to effect good union and also to achieve a pleasing cosmetic result.

Twenty years ago, while I was assistant to Dr. Ferris Smith, I read a paper entitled "Scars". I now, somewhat reluctantly, report that I have little to add to that work. In the intervening time, no new methods of scar management have been developed. Certain long-established principles still prevail, which I shall reiterate.

First, use a right angle incision. A right angle incision to the skin is preferable to the beveled one, as is occasionally advocated, because there is less incised tissue to approximate and, hence, less scar formation in the act of repair.

Second, follow tension lines or natural folds. Whenever possible, incisions should be made in lines of tension—the so-called lines of Langer—or in the natural folds. These tension lines are usually parallel to the muscle fibers so that muscle-pull tends to draw the incised parts together, thus resulting in less scar formation in the way of repair.

Third, insure relaxation of skin edges. The avoidance of tension of the coaptating parts is essential. Accordingly, every effort is made to approximate the subcutaneous tissues in such a way that the skin flaps come together with ease. This relaxation may be accomplished by proper undermining or shifting of the skin, and by suturing together the underlying soft tissues.

Fourth, use fine external sutures. The skin itself may be approximated by intracuticular sutures, either of the single variety or the running type. The skin edges may be further held together by the use of fine sutures so placed as to join exactly the epithelial edges. Various types of skin sutures have been devised but silk, horsehair, and steel are most commonly used. Several kinds of silk are obtainable, either in the braided or twisted form. Steel wire is now available in very small sizes, and is used by a number of operators. However, it is more difficult to handle, and the author finds very little advantage in this particular suture over the silk. Horsehair is advocated by some men, in that it has a certain amount of elasticity which responds to the swelling and retraction of tissues.

Fifth, remove skin sutures early. Early removal of superficial sutures is advisable to avoid stitch scars.

Sixth, support skin edges. After sutures are taken out, the skin edges should

[1] Presented at the Fifteenth Annual Meeting of the American Society of Plastic and Reconstructive Surgery, Kansas City, Mo., November 15, 1946.

be given some support, either by the use of collodion strips or adhesive tape. We find that adhesive strips placed parallel to the incision and extending for about one-fourth inch to one-half inch on each side are very helpful in limiting excess scar formation. These strips should be renewed every day or two and worn for a minimum of four weeks post-operatively. The present adhesive strip is removed with benzine or carbon tetrachloride, and the covered area is exposed to the air for about one hour to avoid skin irritation. In cases of sensitivity to adhesive tape, collodion strips are employed.

However, even after all the foregoing principles have been followed, unsightly scars do result in some cases much to the embarrassment of the operator and the patient. These undesirable scars usually take the form of three distinct types: the wide, flat variety; the hypertrophied scar; and the keloid. The wide, flat scar occurs when the repair process is excessive and pushes the skin edges apart, even though there is no tension. The hypertrophied scar is one in which the repair process overdoes itself and piles up excess tissue above the skin level. The third or keloid is one in which the repair process is unbridled, forming large masses of scar in the repair unit, as well as invading the normal surrounding tissues. Many writers are of the opinion that hypertrophied scar formation and keloid are separate entities, while others consider them to be of common origin. I differentiate the two types in that hypertrophied scar formation limits itself to the incised areas, while keloid extends beyond the incision line, or, in other words, invades tissues.

Various treatments have been tried to correct these three types of unwanted scarring. The wide, flat scar may be excised, and the skin edges again brought together. If the scar is more than one-half inch in width, it is best to excise a portion of the scar itself, leaving enough so that scar may be sutured to scar, rather than again invade normal tissue. In other words, excise a part of the scar within the scar. After an interval of months, the tissues surrounding the scar may be sufficiently relaxed to permit removing the remaining scar and once more suturing the skin edges. In some cases this proves very helpful in the management of wide, flat scars, while at other times the same form of scar recurs, just as in the first excision.

The hypertrophied scar has much in common with the keloid, but does not demand quite such drastic treatment. Mechanically, the hypertrophied scar is dealt with in much the same manner as the wide, flat scar; in other words, it calls for a secondary excision and re-suturing.

Trichloracetic acid 75% or 90% may be used to peel off hypertrophied scar formation. This is a rather tedious type of treatment, and occasionally the acid irritation causes further increase in scarring.

The keloid scar still presents to the plastic surgeon a serious and not completely answered challenge. Excision of a keloid mass frequently results in the formation of another such lesion much larger than the first one, and thus does not solve the problem. The large keloid may be reduced by excising it to within about one-eighth inch of its external border and then suturing together the edges. This method reduces the size of the keloid, but by keeping it within its confines

eliminates the danger of further invasion into the normal surrounding tissues, and the production of a subsequent keloid mass larger than the original, as often seen after complete excision. One should be particularly cautious in excising small scars or keloids in the chest areas of women, because experience has shown that these excisions are usually followed by much larger and denser lesions. These may be caused by the weight of the breasts on the skin, or by lymphatic duct disturbance, or by a combination of both factors.

X-ray therapy is frequently beneficial in retarding keloid formation, and is advisable as soon as the keloid clinically manifests itself. Newly-formed keloids are composed of fibroblastic proliferative tissue and capillaries, both of which are radio-sensitive. Old keloids are made up of dense fibrous connective tissue, and are much more resistant to x-ray or radium. When there is a known tendency to keloid formation, the first x-ray treatment may be given within seventy-two hours after repair in an attempt to limit scarring. A second and third treatment may follow at monthly or bi-monthly intervals. The following x-ray formula, as suggested by Dr. E. F. Merrill, has been applied effectively in many instances: "Small keloids which are not thick can be treated successfully with x-ray—using voltages from 85 to 100 kilovolts, and giving sub-erythema doses. The more extensive and thicker keloids appear to recede more satisfactorily if the kilovoltage is raised to 135 or even to 180, but in any case the sub-erythema dose is used, allowing repetition, if necessary." Be sure to protect the surrounding tissues for a considerable distance beyond the lesion, so that the normal skin is not exposed to x-ray.

Radium is also used in the treatment of keloid. It has been shown that preoperative radiation is useful in retarding the usually prompt recurrences of keloid. It is advisable, therefore, that the radiologist and the plastic surgeon work together in treating these lesions if the best results are to be obtained. Radium is usually preferred to x-ray therapy in dealing with the smaller lesions, while x-ray is used in the more extensive areas of involvement. Within three to five days postoperatively, or as soon as the stitches are removed, sub-erythema doses of radium are applied to the newly-formed scar. Surgical excision is not advocated for the small, young, vascular and rapidly-growing keloids, as the response to radiation therapy alone is satisfactory. The dosage should be precisely localized to the keloid, while the normal skin is shielded with lead foil. The following radium technique is suggested by Dr. Allen Robinson: "Use 120 to 130 kilovolts with 3 millimeters aluminum infiltration, and give 200 'r' at weekly intervals for four or five treatments. Soft beta radiation from unfiltered radium plaques is not recommended because it produces a severe superficial reaction. Therefore, filters are used, depending upon the type of lesion to be treated. Surface application of radium needles or radium tubes screened with 0.3 millimeter to 0.5 millimeter platinum equivalent is used in the treatment of small keloids. The gamma roentgens to be administered may be accurately obtained from tables prepared by medical physicists. One thousand 'r' of gamma radiation is considered an erythema dose; and since repeated sub-erythema doses are employed, 200 'r' to 300 'r' would be the average dose in order

to affect the normal tissue to the least degree possible, and at the same time cause favorable regression of the keloids. The dissolution of keloids takes place slowly, three to six months being required to obtain the end result." Radiation therapy is a valuable adjunct to surgery in rendering newly-formed keloids softer, smaller, and flatter; it often relieves itching and burning; it minimizes contractures and recurrences.

There has been a good deal of discussion as to the part played in the healing process by glandular secretion. It has been noted by some observers that hypo-thyroidism is conducive to hypertrophied scar formation. Clinical findings and thyroid extract therapy have not completely borne out these observations. In the treatment of war casualties, testosterone propionate 10 mg. in oil intramuscularly, three times a week for a period of several weeks, was used with some success in the dissolution of massive hypertrophied scars and keloids following burns.

It is the opinion of the author that there is a close association between excess scar formation and biochemical disturbances. Burns, particularly the third degree variety, produce hypertrophied scar and keloid, not only in the burned area but very frequently in a donor site considerably distant from the burn. This would suggest some chemical change produced by the burn and affecting the body tissues generally. It has been noted also that persons with positive tubercular reaction are more prone to keloid formation than those with negative reaction. Dark, heavy skins are more likely to develop keloid than light, thin skins and, hence, we have the preponderance of keloid in the dark-skinned races. Chemical research in cases of individuals with tendencies to hypertrophied scar or keloid formation should be continued.

Seatons have been advocated in large hypertrophied scar or keloid masses on the theory that there is some stagnation of the lymph drainage. Clogging of the lymphatic ducts in or about a scar mass must be considered, for it has been frequently noted that hypertrophied scar formation often results after excision of tattoo marks. One of the explanations for this is that the surrounding lymph structures are clogged with dye deposit.

The intent of this paper is to stimulate further interest in a problem which is fundamental in all types of reconstructive surgery. Surgical perfection per se is not the complete answer to obtaining fine scars and, hence, continued research in tissue behavior is essential.

IMPLANTATION OF FASCIAL STRIPS THROUGH THE MASSETER MUSCLE FOR SURGICAL CORRECTION OF FACIAL PARALYSIS

A Report of 11 Cases*

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A most perplexing psychological condition as well as a physical one is usually present in patients suffering from facial paralysis. When the muscles are in repose there exists a sagging of the side of the face and a drooping of the angle of the mouth. Attempts at expressions of joy, sorrow, surprise or disappointment usually result in a freakish distortion due to the imbalance of the facial muscles. An inferiority complex coupled with a morose disposition may develop in these patients as the horror of their defect grows.

The importance of offering improvement and reanimation by means of some type of surgical intervention becomes more significant as the number of injuries to this nerve increases. A more general acceptance of radical operations designed to offer cure in advanced cases of carcinoma has made it necessary to sever the facial nerve in a larger number of instances. An increasing number of automobile accidents has reflected a greater number of injuries to the facial nerve.

Many operative techniques have been suggested to offer reanimation in cases with facial paralysis. Muscle operations have been used when facial paralysis has existed so long that the affected muscles were completely atrophied and no longer responded to the faradic current. In other cases of injury to the seventh nerve, fascial transplants have been used. In still other instances, combinations of procedures have been used in an attempt to restore support and reanimation. A survey of the many methods described reduces the procedures to two fundamental surgical approaches: (1) Use of muscle transplants and (2) support by means of fascial strips.

REVIEW OF THE LITERATURE

Use of muscle transplants—According to Alexander (1), the muscle suspension method was first practiced by Lexer. This procedure consisted of using two strips of the anterior half of the masseter at its insertion, removed and reinserted, one sutured into the upper lip and the other into the lower lip. A slip of the temporal muscle was excised at its origin, brought forward and divided into two segments, one sutured into the upper lid and the other into the lower lid. Halle (2) stated that Lexer's muscle plug operation was based on Wrede's suggestion and was performed in 1908.

Amza Jianu (3) split the masseter muscle and anastomosed both muscle bundles separately, one to the orbicularis oris superior, and the other to the orbic-

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ularis oris superior, and the other to the orbicularis oris inferior. He based his technique upon a modification of the procedure used before by Gomoiu and Jon Jianu, who attempted to transplant the sternocleidomastoid muscle to the lip commissure. The disadvantage of using this muscle is that each movement of the head produces a pull on the commissure of the mouth.

According to Adson (4), Eden in 1911 advised transferring a strip of the masseter muscle from its attachment along the jaw to the angle of the mouth in addition to transferring a strip of temporal muscle to the outer canthus of the eye. Morestin (5) made an incision below the angle of the jaw and separated the superficial soft parts as far as the center of the cheek. The masseter muscle was then exposed. The buccinator was retracted posteriorly and attached by buried sutures to the anterior edge, aponeurosis and superficial muscle fibers of the masseter. Fenwick (6) first grafted a slip of the temporal muscle into the orbicularis palpebrarum and a slip of the masseter into the orbicularis oris. Due to considerable difficulty encountered in getting the slip from the masseter, he discarded its use. Hastings (7) split the left masseter, detached the anterior half from the jaw, and stitched the lower end of the divided portion to the tissues of the angle of the mouth. Pickerill (8) inserted a strip of masseter muscle into the orbicularis oris at the upper angle of the mouth.

Two operations performed by using the method of Eden were reported by Adson (4) in 1925. Results in one case proved favorable. In 1924 Perthes (9) cited two cases treated successfully by the Lexer plastic muscle operation. In 1938 Schmid (10) reported favorable results obtained with the Lexer-Rosenthal method in 3 cases of irreparable facial paralysis. According to Halle (2), Rosenthal expected that the nerves of the implanted muscles would unite with the nerves of the paralyzed muscles and so these muscles would receive new enervation. Rosenthal used the principle of muscular neurotization and obtained good results in nine out of 12 cases (10).

In 1926, Brunner (11) reported the intraoral method of transplanting a portion of the masseter muscle. The chief advantage of the method is that no scar is to be seen on the face. Bunnell (12) used the anterior portion of both the temporal and the masseter muscles with their nerve twigs. Each was prolonged by multiple fascial grafts—nine altogether. These fascial strips were distributed to the various sites of attachment to areas paralyzed from the eye to the chin. The fascial strips from the temporal muscle were distributed about the eye, and those from the masseter were attached about the mouth.

Halle (2) exposed the edge of the masseter upwards to its origin. Two muscle strips were separated parallel to its fibers, a smaller one for the levator anguli oris and a broader one for the orbicularis oris, the latter one being divided into two equal parts and attached to the muscle at the upper and lower angle of the mouth. In 1941, Alexander (1) reported one case of facial paralysis treated by the Halle method of operation. In his estimation, Halle's operation is the most physiologic as well as practical of all muscle suspension methods since all muscle pedicles are utilized properly for function as the motor action of the muscle still runs from origin to insertion after transplantation.

Support by means of fascial strips—In 1913, Busch (13) used a 2 cm. wide strip of fascia lata, which was fixed within the tissues of the angle of the mouth wound, incised just above the paralyzed angle of the mouth. The upper end of the strip was fixed into the periosteum of the maxilla by means of two sutures. This was a modification of his technie reported in 1910 (14), where he reported the use of aluminum bronze wire to lift the angle of the mouth. During the same year, Stein (15) reported having used the Busch operation in two cases of facial paralysis but not obtaining permanently good results, modified the technic by replacing the wire with a strip of fascia lata. In order to prevent irritation in the region of the angle of the mouth, a small injection of paraffin was made into that area. The paraffin was injected two to three weeks before the operation in order to fix it in the tissues. He reported one case treated by means of this procedure in which the results were very satisfactory. The evaluation of the results obtained was made after one year of observation.

In 1926, Blair (16) used two fascial strips, 2 to 3 millimeters wide, taken from the iliotibial band of the fascia lata. These were fastened together to give sufficient length to make one loop. One end of the loop was fixed in the temporal fascia, or in the fascia superficial to the parotid gland while the other engaged the tissues to which the paralyzed muscle or group of muscles was attached. Fine silk sutures were used. Four years later, Blair (17) reported a removal of some of the stretched tissue as well as tendon implantation.

In 1930, Lodge (18) employed fascia lata taken from the outer aspect of the thigh. He made two short incisions exposing the temporal fascia and the internal palpebral ligament respeetively, and a tiny third incision at the junction of skin and mucous membrane at the angle of the mouth. As long a strip of fascia lata as could possibly be obtained, 5 mm. in width, was threaded along a triangular course between the three facial incisions among the atrophied muscles with the aid of a packing needle. The internal palpebral ligament and orbicularis oris were encircled en route. The two free ends were drawn taut, and woven into the fibers of the temporal fascia. In this manner three new ligaments were grafted into the face, corresponding in position to the inferior portion of the orbicularis oculi, the levator palpebrae superioris alaeque nasi, and the zygomaticus major. In 1933, Brooke (19) reported the use of a fascial strip, from the thigh, which was passed from an upper incision made over the zygomatie process to a lower one which was made horizontal at the level of the angle of the mouth but at least $\frac{1}{4}$ inch away. It was then passed around part of the risorius muscle and fascia and finally brought back again to the original incision, where the ends were drawn tight and tied round the remains of the zygomaticus muscle, which served as an anchor.

In 1939, Brown (20) developed a combination plan of operation in which free fascia strips were put subcutaneously through the face and were anchored directly into the temporal muscle and fascia through an opening in the temporal region. In 1944, Hanrahan (21) advocated a combination of spino-facial anastomosis plus fascial strips in paralysis of less than a year's duration. The two were done at the same operation; the ends of the fascial strips being tacked

down to the temporal fascia. He felt that in cases of paralysis existing over a year the return of motor function was not attainable, and the use of fascial strips only was indicated.

In 1928, Fischer (22) reported the use of fascial strips sutured to the fascia of the masseter muscle. He stated that the priority of the operation belonged undoubtedly to Kirschner who described an indentical method of fascial transplant in facial paralysis in 1913. The loop of fascial strip which he used took in the insertions of the musculus zygomaticus and the musculus risorius at their points of insertion at the angle of the mouth. The two ends of fascia were knotted together and fastened to the fascia of the masseter muscle.

DISCUSSION

Results obtained by the use of muscle transplants have been fairly satisfactory in some instances but in others they have been questionable. Disturbance of nerve supply to the muscle utilized, atrophy of the transplanted muscle subsequent to operation, and a lack of coordinate movement in that portion of the face where reanimation is attempted have all been complications which serve to make this procedure less desirable.

We feel that fascial strip transplants offer the most satisfactory results of the two procedures metioned for the correction of facial paralysis. The method of choice is one designed to give reanimation as well as support to the involved side of the face. The use of fascial strips solely for support of paralyzed muscles is offering only slight improvement. In order to offer reanimation along with support, one must utilize muscle pull associated with support. This result is impossible to attain when fascial strips are anchored to bone, periosteum, or when the strips are attached to the fascial covering of the given muscle. To utilize muscle pull along with support one should select a muscle which, because of its power of contraction and its relative closeness to the area to be reanimated, is most desirable. Logically, this would dictate the use of the masseter muscle since it is probably the most powerful muscle of the face and is adjacent to the paralyzed muscles. The fascial covering of the masseter muscle should not be used as only limited motion can be obtained by attaching fascial strips to this covering. Limited motion can be verified by grasping the fascia with an artery forceps and seeing graphically the excursion of the pull and feeling the degree of the pull transmitted to the fixed forceps while the muscle undergoes contraction. If these observations are compared with the visualized excursion and the transmitted pull imparted to a fascial strip which incorporates a bundle of muscle fibers from the masseter muscle at its middle, it will be noted that both the excursion and the transmitted pull are considerably greater than that noted when the fascial strips are attached to its fascial covering.

TECHNIQUE

Under local anesthesia, three strips of fascia lata about 25 cm. long and about 1 cm. wide are removed from the patient's thigh. The exact location of the anterior border of the masseter muscle is determined by palpation when the

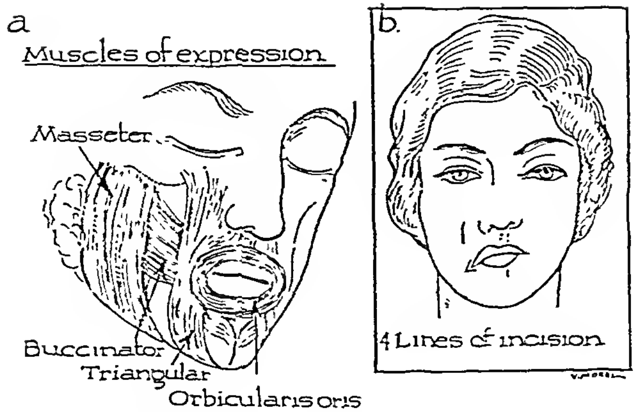


FIG. 1

A. Drawing showing some of the important muscles of expression.
B. Drawing showing the sites of the four skin incisions utilized in this operation.

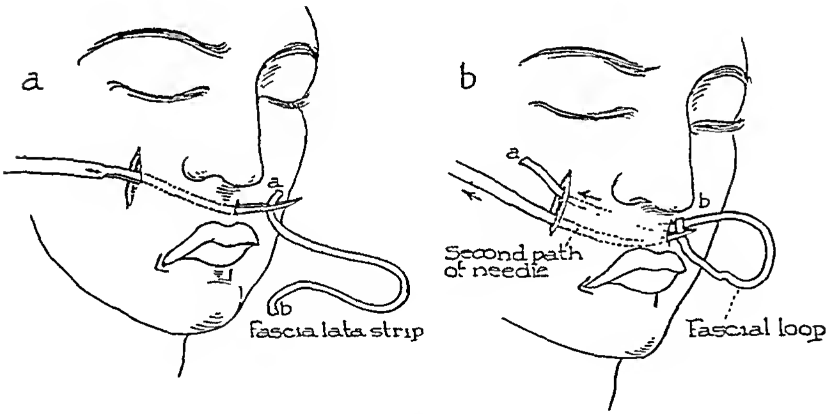


FIG. 2

A. Drawing showing the course of the Reverdin needle after it has been inserted through the incision over the masseter to go forward beneath the skin and out through the incision of the upper lip. Here the end of the fascial loop is grasped in the Reverdin needle before being drawn through the incision in the upper lip and thence backward beneath the skin to emerge through the incision over the masseter muscle.
B. Drawing showing the course followed by the Reverdin needle in its second insertion through the incision over the masseter muscle forward beneath the skin to emerge through the incision over the upper lip at a lower level. The second end of the fascial loop is grasped and drawn backward along this same course to emerge through the incision over the masseter muscle.

muscle is taut. An incision is made directly over the anterior margin of the masseter muscle, to properly expose it. On the opposite side of the face, a small incision is made through the skin of the upper and lower lips, past the median

line, for about 1 cm The object of putting the two small incisions beyond the median line to the opposite side of the face and not at the median line itself, is to establish a counterpull against a functioning muscle. This also lessens to a slight degree the exaggerated pull of the unparalyzed muscle making it easier for the patient to establish coordinate movement through contraction of a muscle whose function is normally disassociated with the movement of the muscles of expression.

After carefully exposing the anterior half of the masseter muscle bundle a large Reverdin needle is inserted into the incision and passed through the sub-

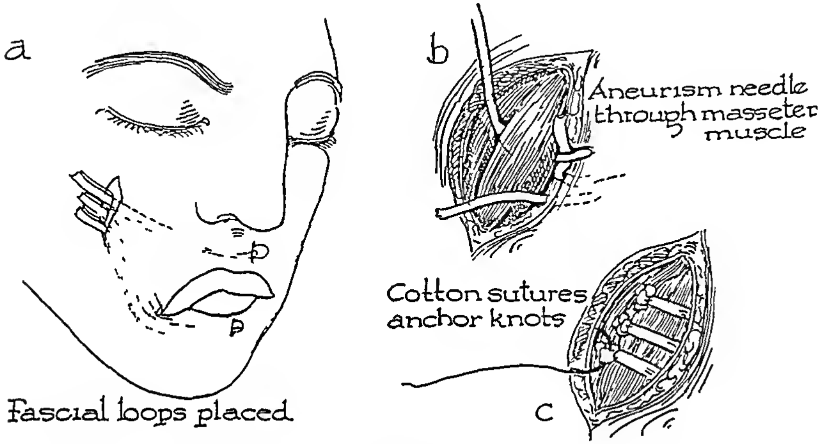


FIG. 3

A Drawing showing the position of the three fascial loops after implantation beneath the skin prior to the incorporation of the fascial loops through the anterior half of the masseter muscle

B Drawing showing the manner in which one end of each fascial loop is passed through the eye of an aneurysm needle which has previously been inserted through the anterior half of the masseter muscle Subsequent to this the loop is drawn backward and upward so that when it is tied with its fellow the loop is securely anchored around the anterior half of the muscle.

C Drawing showing the placement of the fascial loops after they have been tied securely around the anterior half of the masseter muscle and also the manner in which the knots are securely anchored by reenforcement sutures of cotton This latter procedure prevents the fascial knots from becoming loose and subsequently coming untied

stance of the lip beneath the skin until it emerges through the incision in the upper lip, past the midline. One end of the fascial strip is then grasped and drawn along the tract established by the Reverdin needle until it is brought into the area exposed by the incision made over the masseter muscle. The same procedure is again carried out except that the course of the Reverdin needle is directed forward and slightly downward toward the angle of the mouth and thence forward beneath the skin at a level just above the vermillion border, until it emerges through the incision of the upper lip. The other end of the fascial strip is grasped and drawn back along the course established by the needle

in its second insertion beneath the skin. A similar course is established by drawing a fascial loop from the incision in the lower lip, past the median line, to bring the two ends of the fascial strip out into the wound over the masseter muscle. A small semilunar incision is then made just posterior to the angle of the mouth and by the above described procedure a fascial loop is drawn through the semilunar incision to the wound over the masseter muscle by a large Reverdin needle. Subsequent to this, the anterior one-half of the masseter muscle bundle is isolated and an aneurysm needle is passed through the entire thickness of the muscle to incorporate its anterior half. One end of the fascial loop incorporated in the substance of the lower lip is threaded through the aneurysm needle and drawn

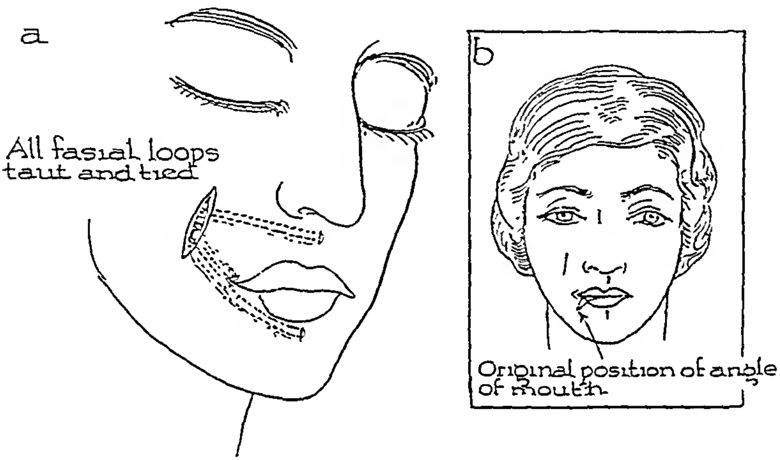


Fig. 4

A. Drawing showing the relative position of the implanted fascial loops after they have been tied around the anterior half of the masseter muscle. Note that all loops have been drawn sufficiently taut before being tied to pull the relaxed tissues upward and backward.

B. Drawing showing the relative position of the mouth on the paralyzed side following completion of the operation.

through the masseter muscle. The two ends of the fascial strip loop are drawn sufficiently taut to pull the lip and angle of the mouth upward about $1\frac{1}{2}$ cm. and backward approximately $2\frac{1}{2}$ cm. A second knot is then placed in the fascial loop and held thoroughly anchored by means of No. 30 white cotton sutures. The same procedure is carried out with the fascial loop which was anchored at the angle of the mouth, placing the fixation through the masseter muscle above the level of the loop from the lower lip. Lastly, the fascial loop from the upper lip is anchored in a similar manner superior to the other two loops. The wound over the masseter muscle is closed by deep retention sutures of cotton followed by a layer of interrupted dermal sutures for the skin. The other wounds are closed in the same manner. Gauze strips fixed by collodion are applied to support the lip for a period of sixteen to twenty-one days. Subsequently patients

are then permitted to begin exercises by contracting the masseter muscle. A short while after exercises have been started the patient is taught to look in a mirror when practicing in order that he may develop coordinated movements between the unparalyzed muscles of the opposite side of the face and the reflected pull of the fascial strips while the masseter muscle is in a state of contraction. Surprising results may be obtained if a patient is deeply concerned and willing to practice regularly.

REPORT OF 11 CASES

Eleven operations designed to offer support and reanimation to patients suffering from the defects associated with facial paralysis have been performed during the past twelve years. The principle of transplantation of slips of the masseter muscle was utilized for one of these operations. Because of the extraordinarily long incision necessary to expose the muscle along with the difficulty of transplanting and anchoring the muscle strips, this procedure was supplanted by another. The second surgical procedure was performed in a manner which utilized fascial strips incorporated in the substance of the upper and lower lips and into the tissues at the angle of the mouth, and then anchored into the substance of the masseter muscle. The latter procedure has reflected satisfactory results, giving support as well as a fair amount of reanimation to the relaxed tissues. The technique is more simple than many described since all important structures are under direct visualization. The technique has subsequently been changed in selecting the incision which permits direct visualization of the masseter muscle. Instead of placing the incision along the lower border of the mandible, it is now placed slightly forward to the anterior margin of the masseter muscle, approximately at the usual location of the nasolabial fold, thus rendering the scar less conspicuous. The incision at the angle of the mouth may be made as a triangular shaped incision which separates the skin and mucous membrane along the mucocutaneous margin at that site. The resulting scar from such an incision is always minimal. Three of the nine cases treated by this procedure showed infection sufficient to produce a rather free amount of purulent exudate. None of the three lost all implanted fascia. Two of the three infected cases lost sufficient fascia to reflect practically no function to the lower lip; while the third is showing rather satisfactory reflection of reanimation at this time. Where preserved fascia was used in one of the nine cases treated, all reflected pull to the upper lip was lost, thus necessitating a second fascial implant of the patient's own fascia. All eleven cases, following complete healing, reflected improvement from the standpoint of support and rather satisfactory improvement as regards reanimation.

Observations and experience gained from the surgical management of the eleven cases reported have caused me to feel that the operation which offers support and reanimation in cases of facial paralysis, by means of fascial strips which connect paralyzed muscles with a functioning masseter muscle, is the operation of choice. Certainly when one compares the mask-like features of a patient with facial paralysis with the support and reanimation which this operation offers, there is no question regarding the judiciousness of the operation.

C D

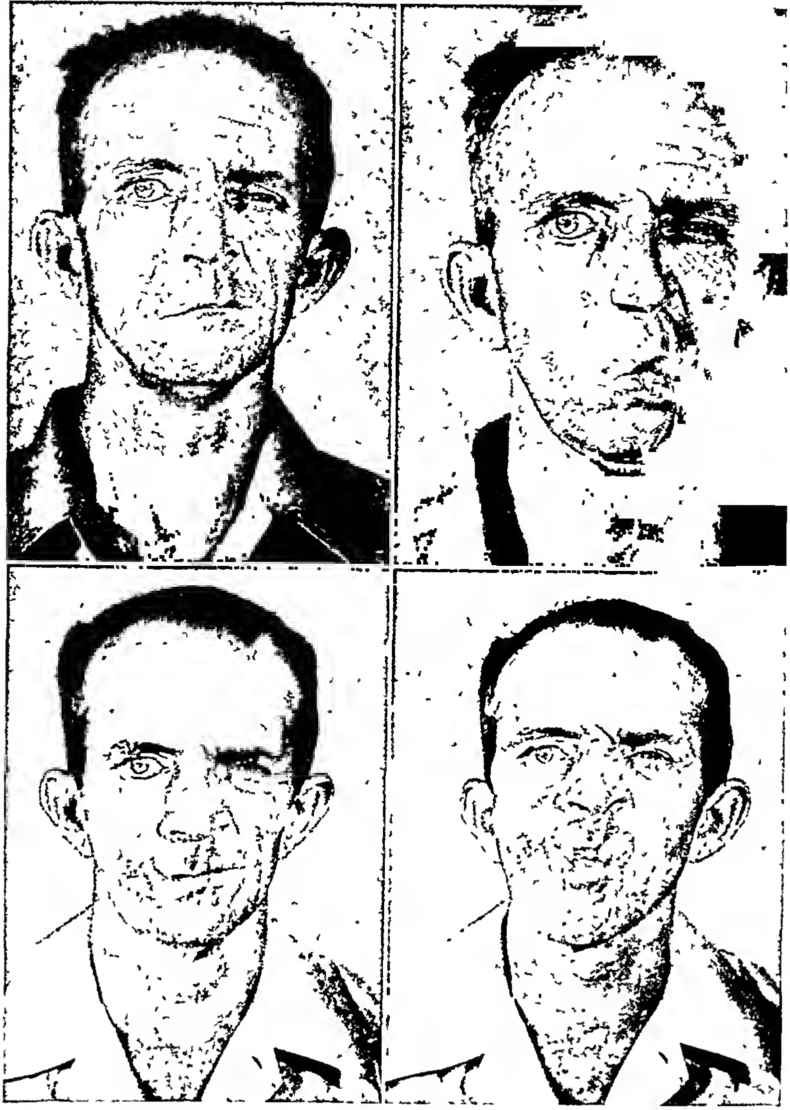
CASE 1

A. Photograph showing patient with facial paralysis resulting from complete removal of parotid gland and capsule, twelve to fourteen years ago. This photograph shows patient's face in complete repose with eyelids closed.

B. Photograph of patient showing reflected pull of the unparalyzed muscles on the left side.

C. Photograph of patient showing defect and contour built out with implant of fat graft and reanimation of the paralyzed side of face by means of fascial transplants attached to upper and lower lips at the angle of the mouth and thence backward into the body of the masseter muscle. Note the improvement in support on that side of face. No attempt was made to correct the paralysis of the eyelid.

D. Photograph showing the same patient subsequent to implant of fascial strips reflecting the backward pull which takes place when the masseter muscle is contracted.



C D

CASE 2

A. Photograph of patient with facial paralysis of approximately ten years duration. Note the reflected paralysis of right side of face, including the drooping of the angle of the mouth and the relaxed eyelids on the right when patient contracts the left side of face with unparalyzed muscles.

B. Photograph showing the extreme amount of pull to the left when patient contracts the unparalyzed muscles while attempting to purse the lips. It is extremely difficult to obtain sufficient cooperation to demonstrate the movements desired because of patient's marked deafness.

C. Photograph showing patient following the implant of fascial strips to the upper and lower lips and at the angle of the mouth, followed by incorporation of the strips into the bundle of the masseter muscle. No attempt at correction of the paralysis of the eyelid was attempted.

D. Photograph showing reflected pull on the fascial strips in the right side of face, when masseter muscle is contracted.

C D

Case 3

A. Photograph showing relaxation associated with facial paralysis resulting from removal of left parotid gland and capsule because of tumor. Note unusual sagging of the soft tissues of the face in repose.

B. Photograph of same patient showing the pull on the right side of the face when unparalyzed muscles are contracted. Note also the apparent contraction on the left side of the face. This was first noted following the examination of photographs and was difficult to explain until the patient stated she had learned to reflect expression by contracting the left masseter muscle.

C. Photograph showing patient about two weeks following operation. Note the support of the angle of the mouth on the paralyzed side following the implant of fascial strips.

D. Photograph of patient taken approximately two weeks following operation showing the amount of pull on the paralyzed side of face which is evident when the masseter muscle is contracted.

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THE CORRECTION OF SOME FORMS OF ACQUIRED PTOSIS*

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Acquired or symptomatic ptosis is a condition quite different from congenital ptosis when one considers its correction. A small number of these cases of acquired ptosis are not surgical problems, the remainder can be corrected surgically, but only when the conditions present are handled anatomically as well as physiologically.

In the consideration of congenital ~~potsis~~ ptosis there are many various surgical procedures which can be used depending upon the anatomic situation present. The two condensed tables which follow will illustrate this; the first is the author's classification for congenital ptosis; the second is his classification for acquired ptosis.

It is quite evident in looking at table 1 that the same surgery for Class 2 could not apply to that of Class 6, nor the surgery for Class 1 to that of Class 5. Even within the confines of a subdivision itself degrees of levator involvement modify the surgical demands for correction.

A small number of cases of acquired ptosis can be handled well by fitting them with their anatomic conditions present into similar categories as seen for con-congenital ptosis. The major number of cases of acquired ptosis, however, fall of necessity into three general surgical subdivisions. These are; utilization of cicatricial bands as achieved by the Hess technique; the utilization of the orbicularis as carried out by means of the Reese technique; and the ability to use the levator as we see in the classical levator advancement with resection and with tarsectomy. Three cases will be presented to illustrate this dictum.

The Hess procedure is a poor one for all but a few cases of bilateral ptosis who have a complete paralysis of both levators. Even in these instances a better surgical procedure is the utilization of fascia. The indication, as applied to congenital ptosis, suggests the almost imperative use of this operation. In considering acquired ptosis, however, many cases of reconstructed upper lid are thick, ptotic, sparse with orbicularis fibers and have deeply lined cicatrices, which may swing posteriorly towards the superior cul-de-sac. A small number of these cases have the eyeball still intact, a larger number of them are complicated by a surgical anophthalmia. Some of these latter cases have had mucous membrane or even skin grafts into the socket for the correction of a contracted socket. Such conditions need the Hess procedure. Figure 1 is a young man with a completely paralytic ptosis following a traumatic enucleation completed surgically. He had a large mucous membrane graft into the superior cul-de-sac, and two operations to the superior surface of the lid for the removal of cicatrices therein[1]. (a) of figure 1 shows the boy prior to the ptosis surgery. (b) of the

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[1] Principles and Practices of Ophthalmological Surgery, Lea & Febiger, Phila., 3rd ed., p. 476.

same figure is the case with sutures in place. (c) shows his correction. The patient now wears his ocular prosthesis.

In utilizing this technique for this type of case the surgeon must be most meticulous in splitting off the skin surface with any remnants of orbicularis and fascia from the deeper structure. Over-correction is quite impossible in some instances; in others however, it could be very easily obtained. The more flaccid and thin the substance and thickness of the lid, the easier is an over-correction possible.

TABLE 1*

Class 1.	Unilateral ptosis without superior rectus involvement.
Class 2.	Unilateral ptosis with involvement of the homolateral superior rectus.
Class 3.	Bilateral ptosis without superior rectus involvement.
Class 4.	Bilateral ptosis with bilateral superior rectus involvement.
Class 5.	Unilateral ptosis with weakness of both superior recti; usually more marked, however, in the homolateral eye.
Class 6.	Ptosis with more or less complete third nerve and even sixth nerve paralysis.
Class 7.	Ptosis with the classical jaw-winking reflex; the Marcus-Gunn syndrome of misdirection of developing fifth cranial nerve and tracts and oculomotor nerve fibers.
Class 8.	Ptosis with the Duane retraction syndrome.
Class 9.	Ptosis with neurofibromatosis.

* Transactions American Academy of Ophthalmology and Otolaryngology, March-April, 1946, page 148.

TABLE 2*

Class 1.	Traumatic peripheral ptosis.
	Cicatricial and with soft-tissue contraction.
	Following destruction of soft and osseous tissues.
Class 2.	Traumatic, central and cerebrospinal.
Class 3.	Peripheral, inflammatory or neoplastic (intraorbital, pathologic changes).
Class 4.	Atonic ptosis.
Class 5.	Neuromuscular disturbances (essentially myasthenic).
Class 6.	Ptosis of cervical sympathetic involvement.
Class 7.	Ptosis from third-nerve involvement.
	Peripheral, extracranial.
	Peripheral, intracranial and infranuclear, traumatic, neoplastic, and vascular.
	Nuclear and intranuclear, inflammatory, syphilitic, degenerative, neoplastic.
Class 8.	The pseudo-Graefe syndrome.
Class 9.	Ptosis of hysteria.

The second principle is the use of the orbicularis fibers in cases in which the trauma resulted in the loss of elevation of the lid. Orbicularis fibers, when transplanted, degenerate into cicatricial bands, but in spite of that they permit a much greater postoperative motility to the lid than that possible after the best of Hess corrections. There is never any postoperative lagophthalmos, the orbitopalpebral fold is intact, and the physiologic function of the lid following this operation is much better. In certain cases, one can consider it normal after surgery for completely paralytic ptosis following the sectioning of a levator to

correct the Marcus Gunn jaw-winking reflex;—which illustrates this statement beautifully.

Figure 2[2] is a young man who had lost his left eye in a stevedore fight with terrible lacerations of his upper and lower lids, and of the ocular muscles in his right eye. The weapon with which he was injured was the classical stevedore hook, a vicious weapon under any circustances (a) and (b) are illustrations of his condition following the simple enucleation on the left, and recovery from the emergency surgery done to the right upper and lower lids. The eyeball was intact here, though it cannot be seen in spreading of the lids, as shown in figure

FIG 1

FIG 2

(b); the internal rectus had been torn, as well as the levator and superior rectus, and there was a very extensive symblepharon over the internal canthal angle. The first surgery in this case was the correction of the symblepharon by a mucous membrane graft, the muscle surgery necessary to move the eyeball in to the midline, and the resection of the furrows of cicatrix in the lower lid. Following this the patient had a rather uneventful orbicularis transplant, according to the Reese technique, to the deep layers of the aponeurosis of the occipito-frontalis.

There was one other procedure which one might have considered here, that is

[2] Ibid, p 397

the use of a sling of fascia lata to the occipitofrontalis. This form of surgery is not to be used unless it is absolutely necessary. Thick, wieldy, immobile lids can only be corrected by that technique. It never gives as pretty a cosmetic appearance. As said a moment ago, when the procedure, that is the use of fascia lata, must be used it is a most satisfactory and valuable technique.

Figure 3 illustrates such a case.[3] The ptosis of this patient was accompanied

Fig 3

Fig 4

by a tremendous amount of lid thickening. Even the Hess procedure could not have elevated this lid with its thick, fibrous, cartilagenous like consistency. It followed extensive surgery for a congenital neurofibromatosis.

When utilizing the orbicularis fibers, the surgeon should attempt to obtain a thick roll of fibers before this is detached at the canthal extremities. If the in-

[3] Ibid, p. 399.

cision is made parallel to the lid margin, and slightly closer to the lid margin than the middle point of the lid, then it is possible to mold these fibers towards a roll from above downward and from below upward. The tunnels for the transplantation of the fibers should be above the upper margin of the eyebrow, they should be made from above downward converging towards each other, and must pass through the deep layers of the aponeurosis of the occipitofrontalis.

A third procedure is that connected with the levator itself. A small number of such cases are rather simple. Figure 4 is such an instance. In this there was a partial sectioning of the levator from a stab wound through the upper lid into the orbit from a piece of glass. That which one had to do here was to open through the superior cul-de-sac, find that portion of the intact levator still present, and from there proceed posteriorly, picking up the retracted margin of the levator aponeurosis. As each portion is brought forward, a suture is

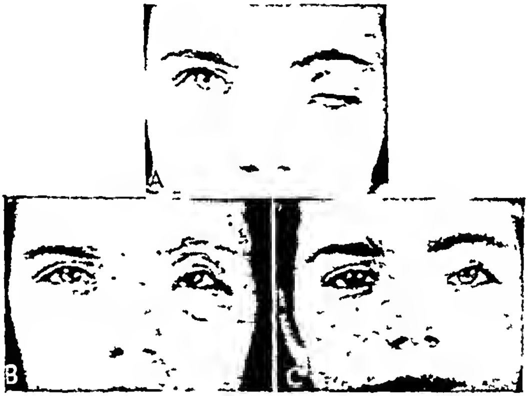

FIG. 5

placed in that until the entire curve of the retracted margin of the aponeurosis is mobilized with from three to four sutures on its margin, preparatory to a formal re-attachment to the superior cul-de-sac and the superior tarsal plate. That portion of the levator which is still normally adherent should now be detached so that it will lie in smooth continuity with the previously sectioned portion. A small tarsectomy will be necessary, otherwise a satisfactory lid fold will be absent after recovery.

A better case illustrating the principle is seen in figure 5.[4] (a) of this shows the patient following recovery from an osteomyelitis of the rim of the orbit. She had had a traumatism with sequestrum formation. The original injury was an automobile accident. Sequestrectomy was done, and a cartilage implant corrected the bony defect. (b) of the illustration shows the patient after an external route levator advancement and tarsectomy, the so-called Everbush procedure. The epicanthus, which is here seen was then corrected, and a dacryo-

[4] Ibid, p. 379.

cystorhinostomy done at the same time because of an empyema of the lacrimal sac. (c) illustrates the end result.

This case could have been handled as well, or perhaps even better, through a trans-conjunctival approach to the levator, but the scar tissue in the septum orbitale was rather firm, and it was felt that it would be wiser to approach the levator through the skin surface. Lid closure should be fairly satisfactory after this operation, but it does shorten the lid to a certain extent; more so than with a Blaskovicz technique. The reason this procedure is applicable more often than a trans-conjunctival approach is the ease with which one can remove the superficial and deep lid and orbital cicatrices, as compared to the difficulty one has to do this same reconstruction surgery when using an apprach through the superior cul-de-sac, that is the Blaskovicz technique.

When the tarsectomy is done, a step in this operation, the conjunctiva on the posterior surface of the tarsal plate is to be removed with that portion of the tarsus which is being removed. It is almost impossible to conserve it and it is unnecessary. This, plus the advancement of the levator aponeurosis is responsible for the lid shortening which develops. It is never enough, however, to result in an appreciable amount of lagophthalmos.

CONCLUSIONS

In the correction of acquired ptosis the three basic techniques have been discussed, each of these is to be utilized for a certain group of conditions, and anatomic situations present. Clinically, it seems that best results are obtained if the surgical therapy is matched with these anatomic conditions, rather meticulously. The correction of acquired ptosis, may be technically more difficult than is that of congenital ptosis, but generally speaking the rules for guidance are the same. The Hess procedure has its optimum indications in the correction of ptosis connected with any type of lid reconstruction. While this surgical procedure affects lid excursions by reason of the adhesions formed, this fault is of least importance in these cases. A completely severed levator must be replaced functionally, by utilizing the action of the occipitofrontalis through orbicularis fibers. When the orbicularis is destroyed a fascia lata transplant can be substituted with almost equal functional satisfaction, but less satisfaction cosmetically. A partially sectioned levator can be repaired rather readily because the intact portions, when uncovered, guide one to the edges of the traumatic section now for re-attachment. In many of the cases wherein the levator can be utilized it seems as if the external approach to this muscle gives better end results. Not only can adhesions and other accompanying deformities be removed more readily but the varying degrees of correction necessary estimated more accurately.

Cicatrices, when resected or even released, should be re-sutured in anatomic layers, one suture line to be offset from the other, to permit maximum action of the remaining orbicularis fibers and the levator muscle. Cul-de-sac defects, after scar removal, must be replaced with mucous membrane grafts. Socket

reconstructions should spare the levator if that is still intact. Deformed tarsal plates can be removed at the time of a levator procedure. Surgery which utilizes the occipitofrontalis has no effect on the levator. It is most important to remember that procedures which call for deep or extreme incision, like all traumatisms in the superior ciliary region, must result in scars that inevitably limit the natural movement of the soft parts. This applies to the original traumatisms as well as to procedures on surgical correction.

TATTOOING OF CORNEAL SCARS WITH INSOLUBLE PIGMENTS

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While attempts to conceal or remove corneal scars may possibly be of ancient origin, no definite mention of operations on the cornea can be found in any medical work prior to 1743 (1). In 1837, Bigger (2) suggested the possibility of transplanting the cornea. The first recorded case of purposeful tattooing occurred in 1870, when von Wecker (3) introduced India ink into a scarred cornea to conceal the disfigurement. He previously noted "that in workmen wounded by the explosion of mines, the grains of powder remained in the cornea without producing any remarkable haziness in the surrounding tissue." While Williams (4) and Calhoun (5) deserve credit for presenting the first cases of tattooing in this country, writing in 1874, Mathewson (6) stated, "While thinking of this matter of concealing discolorations of the cornea by tattooing, it has occurred to me that the same principle might be applied to the relief of disfigurements of the face and neck, such as those produced by extensive nevi or other permanent discolorations of the skin, some coloring being used which would produce a natural flesh tint." Permanent color matching of skin grafts and flaps with insoluble pigments was suggested by Blair about 10 years ago, and a method of accomplishing this was recently introduced into modern plastic surgery by his associates, Hance, Byars, McDowell, and Brown (7, 8). Since corneal tattooing did not have the importance of those capital operations which preserve or restore vision, it was temporarily abandoned until about 1925, when Knapp (9) presented a method of introducing chemically a color into the normal corneas of rabbits and into a scarred human cornea. At operation, the scar was denuded of its epithelium, after which a cotton applicator, moistened with 1 per cent gold chloride, was applied to the denuded scar for 2 or 3 minutes. About 15 minutes later, during which reduction of the gold salt occurred, the scar turned dark. Histologic section of rabbits' eyes treated in this manner showed a deposit of fine dark particles in and between the superficial lamellae. While potassium ferrocyanide and ferric chloride produced a temporary blue color in the eyes of rabbits, other metal salts, platinum chloride, gold and silver cyanide, and cobalt chloride, produced no staining. Holth (10) tried Knapp's method, but was unsuccessful.

Kreiker (11) used a 5 per cent solution of gold chloride to color the bulbar conjunctiva of an albino, but the result was "too severe." Aust (12) produced a severe iritis when some of this solution entered the anterior chamber. Karelus (13) in 1926 recommended "subepithelial tattooing" in which he circumscribed

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the scar with a scalpel and undermined all of the scarred area except one small pedicle. The flap thus formed was turned up and the under surface painted with India ink, which was then allowed to dry, and the flap "replaced."

In 1930, Pischel (14) stated that "most results have been disappointing, both to the patient and to the surgeon. A fine black pupil achieved with much effort and some pain becomes, in the course of a few days, wocfully light again. Therefore any improvement in technic or results must be welcomed." It is of interest to note that since this statement appeared more than 15 years ago, only a single article (15) on tattooing of the human cornea has appeared in the American literature.

EXPERIMENTAL STAINING OF THE RABBIT CORNEA

We were first desirous of learning whether certain metallic salts would stain the *normal intact cornea* in the experimental animal, and if staining occurred, what color was produced, and how long it would remain.

48 white rabbits were used for the experiments. Albino rabbits were selected because their eyes are approximately the size of human eyes and the iris is light in color. Solutions of gold chloride, platinum chloride, gold cyanide, silver cyanide, potassium ferrocyanide, and ferric chloride were used in 2 per cent and 5 per cent concentration. Preliminary experiments lead us to believe that a concentration greater than a 5 per cent solution of a metallic salt might injure the human eye.

6 rabbits were deeply anesthetized with intraperitoneal sodium pentobarbital. A speculum was inserted on each side to retract the nictitating membrane and lids. Each rabbit was placed on its right side so that the left eye was up. The left orbit of each rabbit was flooded for 10 minutes with one of the following 2 per cent solutions: gold chloride, platinum chloride, gold cyanide, silver cyanide, potassium ferrocyanide, and ferric chloride. The nictitating membrane and lids were held open for an additional 15 minutes to allow for the reduction of the metallic salt. The rabbits were then turned on the left side, with the right eye up, and the same procedure repeated using a 5 per cent solution of one metallic salt in the right eye of each respective rabbit. The animals were allowed to recover from the anesthesia, and their eyes were inspected frequently.

Although there was slight temporary injection of the cornea and the sclera in all animals, which may have been due to either mechanical trauma or irritation from the solutions, there was no staining of the cornea, conjunctiva, or nictitating membrane in any of the rabbits during the three weeks period of observation.

To determine whether these same chemical agents in either a 2 or a 5 per cent concentration would stain the iris beneath the *denuded cornea*, another group of 12 rabbits was treated in the following manner. The rabbits were divided into 6 groups of 2 animals, and the procedure to be outlined was performed on successive days on each pair. Surgical anesthesia was obtained using intraperitoneal sodium pentobarbital. The rabbits were placed on the right side so that the left eye was up. Sterile technique was observed. A speculum was inserted to retract the lids and nictitating membrane. Using a corneal trephine, a shallow

furrow 3 mm. in diameter was cut in the cornea and all of the corneal epithelium within this area was meticulously removed. A 2 per cent solution of gold chloride was dripped into the operated eye of each rabbit for 10 minutes, following which the eye was exposed to air for an additional 15 minutes to allow for the reduction of the metallic salt. The rabbits were allowed to recover from the anesthesia, and their eyes were observed several times daily thereafter. On consecutive days, another pair of rabbits was similarly operated upon, using a 2 per cent solution of platinum chloride, gold cyanide, silver cyanide, potassium ferrocyanide, and ferric chloride, respectively.

In another group of experiments, 12 rabbits were divided into 6 groups of 2 animals, and although the same type of operation was performed to denude a circumscribed area of the corneal epithelium, in this experiment a 5 per cent solution, instead of the weaker 2 per cent solution, was used. Otherwise the present group was treated in an identical manner.

RESULTS

Gold chloride. About 10 minutes after applying both the weaker 2 per cent solution and the more concentrated 5 per cent solution, a light brown stain began to appear in the area of the cornea denuded of its epithelium in each of the 4 rabbits. The eyes were observed frequently for about 2 hours, during which time there was progressive darkening to a deep brown stain. Within 24 hours, however, a severe iritis was present in the eyes of those rabbits in which the 5 per cent gold chloride had been used. A mild iritis resulted from the instillation of the 2 per cent solution. At this time, the original brown stain was no longer visible, for these areas were covered by a gray-white coagulum. This opalescent membrane persisted for about 10 days, and when the epithelium had regenerated, the denuded areas were opaque and no brown discoloration was visible.

Although a permanent brown stain was produced in the eyes of the rabbits in which the 2 per cent gold chloride solution was used, nevertheless there was considerable vascularization of the cornea present within 2 weeks, so that the regenerated cornea was nebulous. An identical reaction appeared in the eye of each rabbit.

Platinum chloride. Both the 2 per cent and the 5 per cent solutions caused an immediate light brown discoloration in the corneal area denuded of its epithelium. The stains, however, were no longer visible after 10 days, when epithelial regeneration had taken place.

Gold and silver cyanide. A severe reaction was produced in the eyes of all rabbits in which solutions of these metallic salts were used. A cloudy cornea developed in each instance, without discoloration.

Potassium ferrocyanide and ferric chloride. A temporary blue-gray discoloration was produced in the area denuded of its epithelium. Within 24 hours, however, the blue stain had entirely disappeared. A gray opalescent membrane was present until epithelization occurred, and the cornea, in each instance, was cloudy.

Of those metallic salts used in the present experiments, none produced a stain

of the normal intact cornea. Gold chloride in 2 per cent concentration produced a brown stain of the deep lamellae of the cornea when the epithelium had previously been removed. Several additional experiments were performed using 2 and 3 per cent gold chloride in the eyes of rabbits, and stains varying from gray to dark brown were produced. This confirms the work of Pischel (14) who also found that it was impossible to obtain a permanent black stain. The reactions were severe and the discolorations variable, and since there was no means of controlling the degree of coloration, no additional experiments were carried out using the metallic salts.

TATTOOING OF EXPERIMENTAL CORNEAL SCARS USING INSOLUBLE PIGMENTS

Gifford and Steinberg (18) used herpes virus, smallpox vaccine, and trichloracetic acid to produce corneal scars in rabbits. The herpes scars were unsatisfactory because of the severe prolonged reaction which ensued and which periodically flared up the latent herpetic process. Smallpox inoculations formed small, nonvascular scars. Trichloracetic acid produced permanent white scars when the undiluted solution was applied to the scarified cornea of the experimental rabbits.

We have found that 10 per cent formalin when applied to the intact cornea of the albino rabbit uniformly will produce moderately dense, white, permanent, nonvascular scars. Into these formalin scars we injected various insoluble tattoo pigments, which, in turn, led to the injection of these same pigments in human corneal scars.

The *pigments* used in these experiments were the same which were used in the cases to be reported. They were supplied by Fezandie and Sperrle, Inc., 205 Fulton St., New York City. The pigments are insoluble, stable to heat and light, and essentially non-irritating when placed in the cornea or in the skin.

White (Color Index 1264) is a titanium oxide. Barium sulphate may also be used.

Black (Color Index 1311) is magnesium oxide. While this preparation is dark, it is not as black as "concentrated black" (Color Index 1308), which is lampblack.

Blue (Color Index 1285) is cobaltous aluminate and is used for blending.

Red (Color Index 1280) is mercuric sulphide.

Orange (Color Index 1272) is cadmium sulphide.

Yellow and Brown (Color Index 1267) are natural ferric hydrates. For other shades of yellow and brown, one may use the ochers, the metallic oxides, which vary from light yellow to brown and red. The color is controlled by the amounts of hematite and limonite present. The artificial red ochers are produced by heating the natural yellow and brown ochers, thereby converting them to iron oxides.

Instruments. The special tattoo needles (fig. 1) were supplied by the Edward Weck Co., Brooklyn, N. Y.

Corneal scars were produced in albino rabbits by instilling 10 per cent formalin into their eyes. Within 2 to 3 weeks, large, opaque, mature scars had formed. These scars were tattooed with the various pigments previously described, using first a single pigment. Since there was no demonstrable change in the appear-

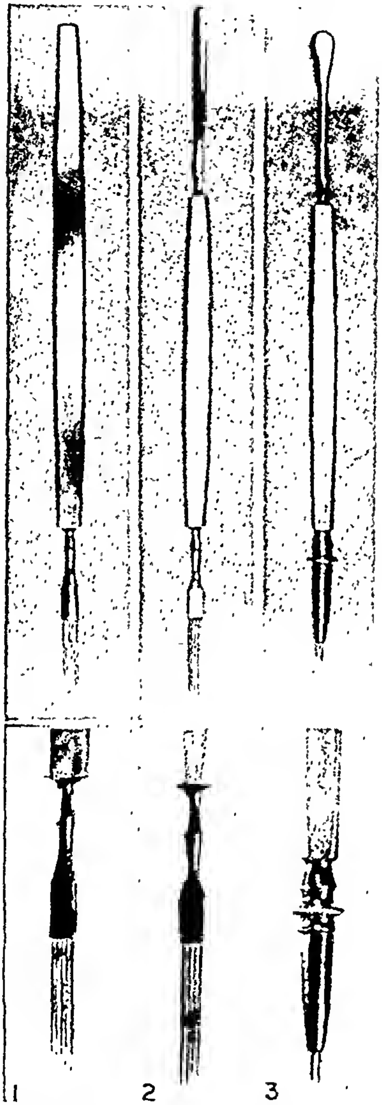

FIG. 1. The special needles, Nos. 1, 2, and 3, were supplied by the Edward Week Company, Brooklyn. They are invaluable also when implanting pigment in free skin grafts and flaps, and when attempting to conceal scars and other disfigurements.

ance of the tattooed area even after several months, when a single pigment had been injected, we began to use combinations of different pigments to obtain

different shades and tones. These injections were made not only in the eye, but also in the skin of human volunteers, rabbits, guinea pigs, and dogs. We noted that one could not obtain the final desired color by mixing the pigments in the palette and then injecting them, but instead, it was first necessary to inject the approximate basic color. Then about a week or 10 days after this basic color had been implanted, the shading and detail colors could be added to obtain the desired final color.

No one has ever demonstrated lymphatics in the cornea. This may account for the fact that there is little, if any, dispersion, diffusion, or change in the color of these pigments in the cornea. This is not true, however, when tattooing the human skin or that of rabbits, guinea pigs, or dogs. Black pigment may appear blue under the skin within several weeks. When attempting to assimilate a black beard, an unsightly blue smudge may result. This change from black to blue may be due, in part, to the yellow filter pigments in the skin Experiments are now being carried out to study this phase of the problem.

When sufficient experience in mixing colors and skill in injecting the pigments had been gained by tattooing corneal scars in experimental animals, our first clinical case was treated in the manner described in the following protocol.

PRESENTATION OF CASES

Case I A 10 year old white girl was admitted to the hospital April 9, 1945 Six years previously, the left eye had been torn and punctured by a barb when she fell into a barbed wire fence The laceration of the globe was repaired at another hospital, and apparently a conjunctival flap was used to repair the defect Although the details following the operation are obscure, the patient has had markedly reduced visual acuity in the injured eye since the accident But of greater immediate importance to the patient was the external deformity of the eye, which had been a constant source of embarrassment

Examination of the eyes disclosed a normal eye with 20/20 vision on the right On the left side, there was a dense leukoma with marked vascularization of the conjunctival flap (figs 2A, 3A). A post-traumatic cataract was present Vision was reduced to gross outline of objects at 2 feet Since the child was extremely self conscious of her deformity, and had been the subject of many unkind and harassing remarks by her playmates, tattooing was decided upon

Insoluble tattoo pigment was injected into the corneal scar on three occasions—April 10, 17, and 23, 1945 Ether was used as the anesthetic agent At the first operation, the basic brown color was inserted after the outlines of the iris and limbus were accurately determined One week later, additional iris tone was added to cover the areas of scar which did not contain pigment The third operation was performed 13 days after the first, and at this sitting, flecks of brown, orange, and red were inserted to accurately match the opposite iris The limbus was then shaded with blue gray pigment Except for photophobia following each procedure, the patient had no discomfort The child was discharged 3 days following the last injection

Photographs (figs 2B, 3B) taken one and one half years later show no fading or dispersion of the pigment. The color is quite similar to that of the opposite eye There has been marked subjective improvement of vision and perhaps of even greater importance, her inferiority complex, which was pronounced before the operations, has disappeared

Case II An 18 year old white girl was admitted to the hospital August 16, 1945 At 3 years of age, she received a penetrating wound of the right eye when she fell on an open

knife, which resulted in immediate and complete blindness in the injured eye. During the ensuing years, the patient became increasingly self-conscious of the disfigurement (figs. 3C, 4A, 4B). Hoping that a corneal transplant might be performed, she sought the advice of ophthalmologists in several large hospitals and clinics. She was told that there were only two procedures of choice—to wear a shell or to have the eye removed. Several shells were

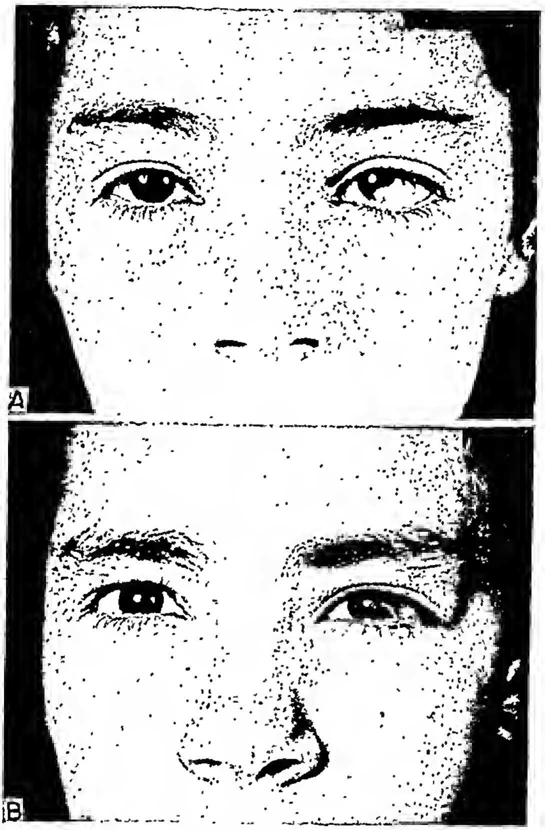

FIG. 2. A. A 10 year old girl with scarring in the conjunctival flap which had been used to repair a barbed wire laceration of the left eye 6 years previously. There was marked vascularization of the leukoma. Insoluble pigments were injected into the corneal scar on 3 occasions within a period of 2 weeks.

B. Postoperative photograph taken one and one-half years later shows no dispersion or diffusion of the pigment. There has been marked improvement in vision.

tried, but without success, for she experienced constant discomfort and excessive lacrimation as soon as the shell was inserted. This may have been due to the calcareous deposits in the corneal scar.

The left eye was normal in appearance, and vision was 20/15. There was no vision in the injured eye. Here there was a dense scar which involved most of the cornea, while the conjunctiva and sclera were clear (figs. 3C, 4A, B). Ocular movements were normal and coordinate. There was an esotropia of about 10 degrees.

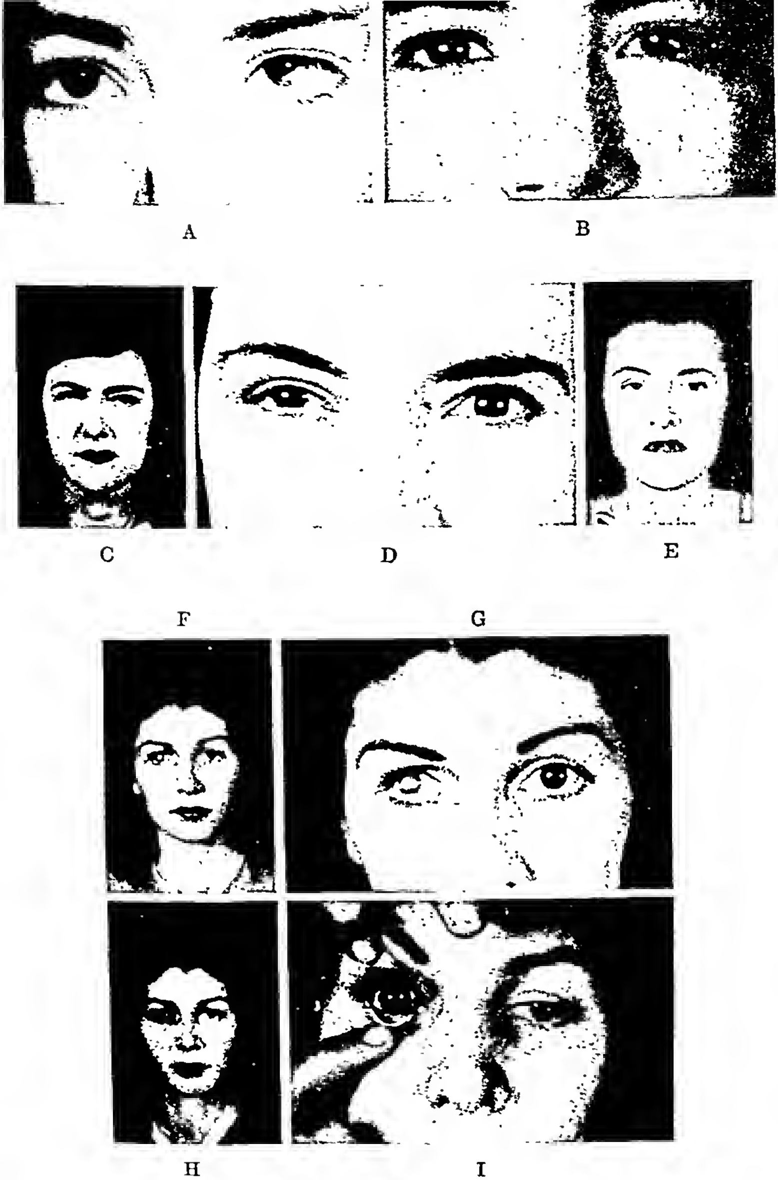

FIG. 3. A., B. Case I. A 10 year old girl with a disfiguring scar of the left eye resulting from a barbed wire accident 6 years previously. Postoperative photographs were taken one and one-half years after injection of pigment. The postoperative darker skin color was due to sun-tan.

C., D., E. Case II. An 18 year old girl with a dense corneal scar resulting from a penetrating knife wound of the right eye in infancy. Since the patient was not acceptable for a keratoplasty, insoluble pigment was injected. Postoperative photographs were taken one year later.

F., G., H., I. Case III. A 20 year old girl with a disfiguring deformity of the right eye resulting from a can opener injury incurred at about 3 years of age. Insoluble tattoo pigment was injected on 4 occasions which completely concealed a conspicuous and embarrassing deformity.

Insoluble tattoo pigment was injected into the corneal scar on four occasions at intervals of five to seven days, following which a recession of the internal rectus of about 4 mm. was performed by the ophthalmologists to correct the esotropia. The patient returned about one year later, and concentrated black was injected into the pupillary area (figs. 3D, E, 4C, D).

Case III. A 20 year old white girl was admitted to the hospital May 13, 1946. When the patient was about 3 years old, a can opener was accidentally thrust into the right eye. Al-

FIG. 4. A., B. An 18 year old girl with a dense leukoma resulting from a penetrating wound in infancy. She was not a candidate for a transplant operation. Shells could not be worn because of constant discomfort and excessive lacrimation. Pigment was injected into the corneal scar on 4 occasions at intervals of 5 to 7 days, following which a recession of the internal rectus was performed to correct the esotropia.
C., D. Postoperative photographs were taken more than a year following the original injection of pigment.

though the exact sequence of events following the accident was not remembered, she thought that blindness in the injured eye did not occur until some years later. During high school and business college, the patient became increasingly conscious of her cosmetic deformity. Despite numerous attempts, she was unable to obtain treatment of the condition.

Examination of the left eye disclosed no abnormalities. On the right side, there was an extremely dense scar covering almost all of the cornea (figs. 3F, G, 5A, B). The surface of the scar was irregular and contained calcareous deposits. There was no vision in the injured eye. There was an exotropia of about 10 degrees.

Insoluble tattoo pigment was injected into the right eye on 4 occasions at intervals of 5

or 6 days There was only slight and temporary discomfort in the injected eye, whereas an annoying photophobia occurred and persisted in the normal eye for about 2 weeks. Figs. 3H, I, 5C, D show the final result.

TECHNIQUE OF TATTOOING

The operation may be carried out with either general or local anesthesia. The instrumentation for the operation is shown in fig. 6. A speculum is inserted on each side to visualize both eyes simultaneously. All instruments are sterilized

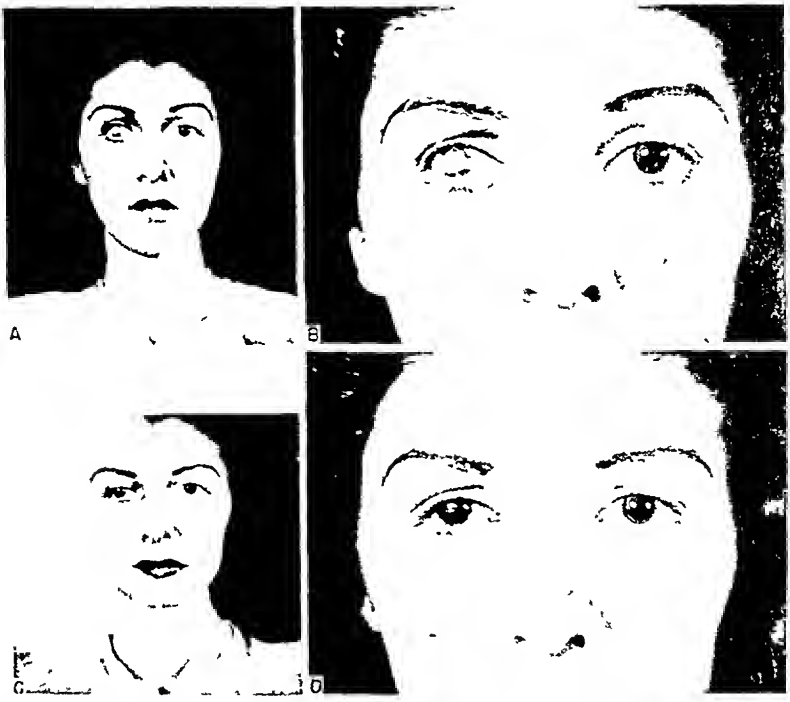

FIG. 5 A, B A 20 year old girl received a can opener injury to the eye when she was about 3 years old, which resulted in blindness in the injured eye. The patient was extremely conscious of the deformity, for a dense corneal scar covered almost all of the corneal area. Insoluble tattoo pigment was injected on 4 occasions at intervals of 5 or 6 days, with result shown in C, D.

by boiling. The pigments are autoclaved and stored in stoppered Wassermann tubes. The eye to be injected is immobilized with forceps which are placed at some distance from the limbus (fig. 8). These clamps are not released until the termination of the operation in order to prevent the pigment from entering the minute perforations of the conjunctiva.

First stage. Planning (fig. 7A). The size of the pupil and iris is determined by careful measurement, with dividers, of these structures on the normal side. The basic color of the iris is obtained by mixing several dry pigments and adding

Insoluble tattoo pigment was injected into the corneal scar on four occasions at intervals of five to seven days, following which a recession of the internal rectus of about 4 mm. was performed by the ophthalmologists to correct the esotropia. The patient returned about one year later, and concentrated black was injected into the pupillary area (figs. 3D, E, 4C, D).

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their comfort they are placed in a darkened room. Although there is some injection of the eye, which lasts for about one week, discomfort is usually not present after the first or second day.

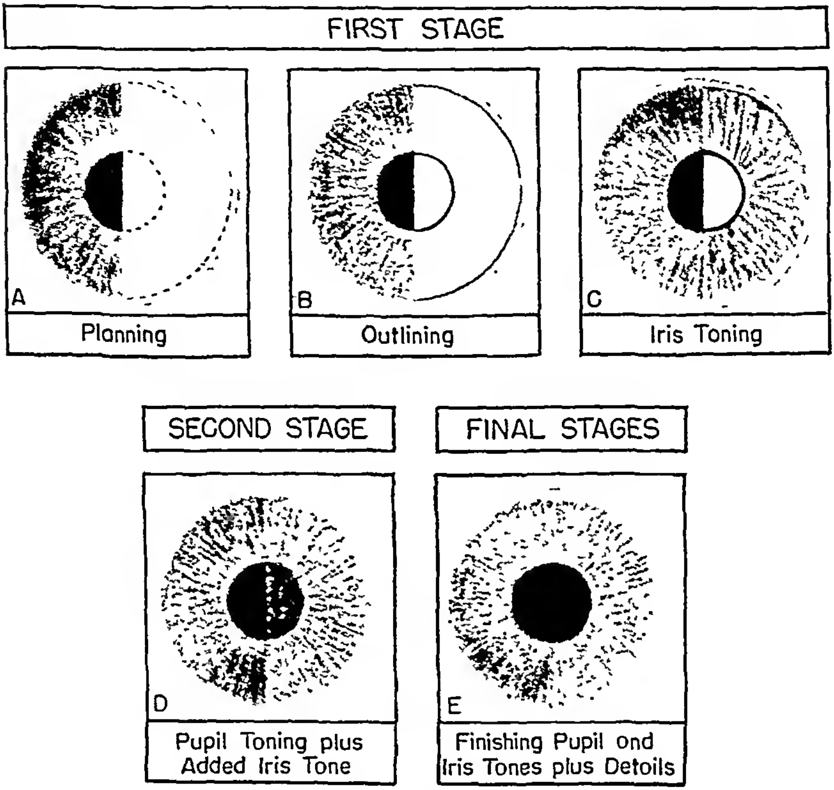

FIG. 7. Corneal scars are of infinite variety, form, and contour. Since eyes possess many colors, shades, and tones, an outline for tattooing the cornea, which is applicable in all cases, is presented

A. *Planning.* The size of the pupil and iris are accurately determined. The pigments are mixed to obtain the primary basic color.

B. *Outlining.* The periphery of the cornea and pupil are injected with the basic color

C. *Toning* Iris and pupil tone are added by tattooing from the periphery toward the center to obtain the effect of normal striation of the iris The pupil is stippled solid black

D. In the second operation, additional iris and pupillary tone are added until no areas of scar are visble.

E. Several additional operations may be necessary to produce the desired final result The iris is flecked with red, orange, blue, green, brown, or yellow to accurately match the normal eye. The diffused effect of the limbus is produced by injecting the periphery of the iris with blue pigment to which black has been added The light zone surrounding the pupil is produced by injecting a contrasting light pigment.

Second stage (fig. 7D). Although we always attempt to make the iris homo genous at the first sitting, we have never been able to accomplish this end. This

saline until the consistency of a thin paste is obtained. A small amount of the mixed pigment is then spread thinly on the gloved finger and compared with the color of the iris on the normal side. This basic color should be slightly darker than the normal iris. Then using a No. 1 or No. 2 tattoo needle (fig 1), the periphery of the cornea and limbus to be tattooed is *outlined* with the basic color pigment (fig. 7B). Meticulous care should be exercised in defining this border. The same procedure is performed to outline the pupillary margin. It is important to insert the needle at an angle of 45 to 60 degrees (fig. 8) so that a line of pigment rather than a tiny spot in or beneath the epithelium will be produced.

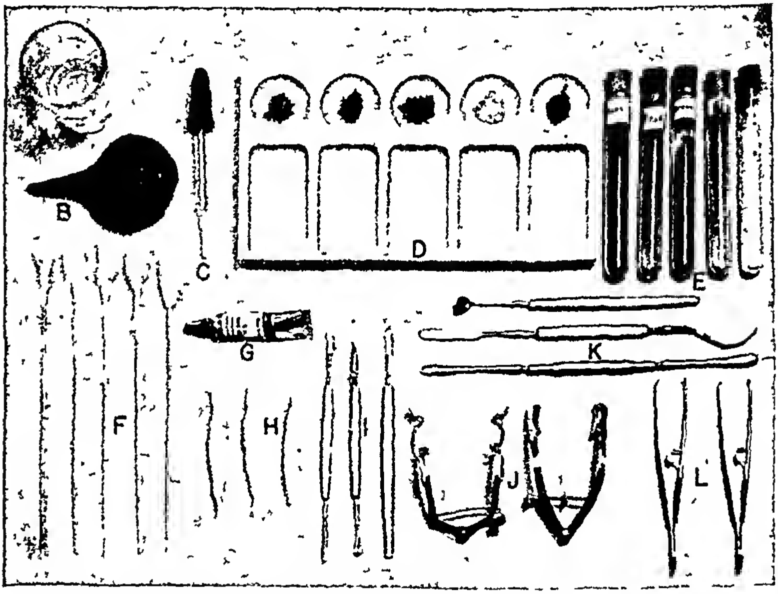

FIG 6 Armamentarium for tattooing the eye All instruments and materials are sterilized A Saline solution B Irrigating bulb C Medicine dropper D Porcelain palette E Pigments F Applicators G Ophthalmic ointment H Torpedo cotton wisps I Special tattoo needles J Specula K Spatulae and curette L Grasphing forceps

Iris toning is then added (fig. 7C) using a No. 3 tattoo needle. To obtain the effect of striation, the pigment is implanted in a radial fashion beginning at the periphery of the cornea and injecting toward the pupillary margin. Care should be taken to avoid entering the anterior chamber. Oblique stippling should be continued until the scarred area is homogenous in color. Black or concentrated black pigment may then be injected into the pupillary area or deferred until the second stage. The eye is flushed with saline, wiped dry with wisps of cotton or applicators, and either boric or penicillin ophthalmic ointment is placed in the eye before the retractors and speculum are released.

Following the first operation, patients may complain of photophobia. For

unless there is some serviceable vision. To the individual, however, a corneal scar may be the primary object of concern, though no vision exists, regardless of whether the deformity is congenital or the result of injury or disease. In the business or social world, the person with an unsightly abnormality may be seriously handicapped and he may consequently develop somatic and psychic disturbances attributable to its presence. In many instances, these visible and conspicuous nonconformities are more harassing than congenital or acquired defects in other parts of the body. It is true that many individuals quite readily compensate for physical or physiological impairments, but in the case of ocular disfigurement, there is no mechanism that will shield a defensive individual from a continued attack upon his self-esteem, for his inner security is assailed each time he looks into a mirror. The unfortunates, children or adults, should, therefore, be given an opportunity to have this barrier removed, even though vision cannot be restored and life is not endangered by the affliction. They should not be encouraged to endure the misery and abuse to which they are predestined; for no one knows the indelible mental effects produced on the afflicted. The need for plastic or ophthalmologic surgery for the correction of the deformity and the elimination of the handicap and the possible mental sequelae is, therefore, evident.

In recent years, keratoplasty has attracted much popular interest and as a result many blind persons have sought a transplant operation in the hope that their sight could be restored. Many, however, have been disappointed because numerous instances of blindness are due to causes other than opaque cornea. Among the types of corneal opacities covering the pupillary area, some are susceptible to treatment by corneal transplantation, which gives the best results as far as improvement of vision is concerned. Other opacities are unfavorable for keratoplasty because of excessive density of the scar or pronounced superficial vascularization, which would render the transplant nebulous or opaque.

Most eye surgeons agree that an individual basically blind from a complete corneal opacity, whether superficial or deep, is entitled to the benefit of a corneal graft. However, Knapp feels that as long as there is a small area of reasonably clear cornea present in the interpalpebral fissure, the operation of choice is not keratoplasty, but rather, corneal tattooing, followed by optical iridectomy. A corneal leukoma or macula over the pupillary area may give rise to diffusion of light within the eye. The scar may thus act as a frosted glass in front of the normal eye. In the place of the normal refraction of the light rays on to the macula of the retina, there is widespread dispersion of the rays at all angles. This phenomenon produces blurred images and diminishes visual acuity. This reduced vision varies with the density of the scar. Knapp (15) has stated that if the opacity could be converted from one which transmits dispersing pencils of light throughout the eyeball, to one which would absorb the light rays, the disturbing element in the production of good vision would be eliminated. By tattooing a central corneal opacity encroaching upon the pupillary area, but not completely occluding it, one creates a condition comparable to a contracted pupil. Increased light may result, since some of the annoying peripheral rays are ob-

is not due to fading, but rather, to an insufficient number of minute injections made at the first operation. In the second operation, additional iris and pupil tone are added, so that no areas remain which do not contain pigment. The reaction following this operation is usually not as marked as that following the first operation, and in many instances, the injection of the operated eye has subsided within several days.

Final stages (fig. 7E). If the operator is satisfied that the basic iris color is well matched with the opposite eye and that there are no areas of untattooed scar visible, the iris is then flecked with orange, yellow, dark brown, blue, or green to match the normal side. The limbus or the periphery of the iris should not be a sharp line, but rather a diffused one. This blue-gray effect is produced by tattoo-

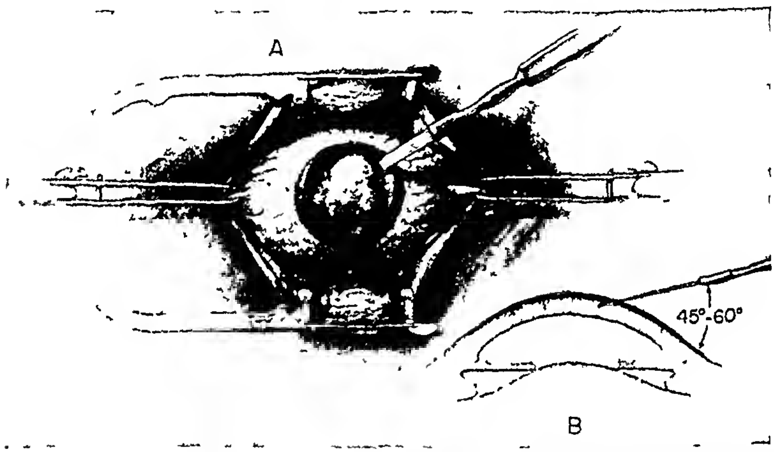

FIG. 8 A A speculum should be inserted on each side to visualize both eyes simultaneously. The eye to be operated upon is immobilized with grasping forceps placed at considerable distance from the limbus After applying these clamps, they should not be released until the termination of the procedure in order to prevent pigment from being washed into the holes in the conjunctiva

B. The tattoo needles should be held at an angle of 45 to 60 degrees so that an oblique line of pigment will result.

ing the periphery with blue pigment to which black has been added. In many instances, a light zone of pigmentation surrounds the pupillary area. This effect can be achieved by injecting the rim of the pupil with a light pigment.

DISCUSSION

Though tattooing the eye does not have the importance of those operations which preserve or completely restore vision, it may confer a great benefit upon patients by helping to conceal a marked or even embarrassing deformity. Since the sequelae of injury or disease to the eyes are so disfiguring, the plastic surgeon or ophthalmologist may be called upon to improve the appearance of the part that remains. To many physicians, the eye may be an uninteresting part of the body,

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structed. Instead of developing spherical aberration, with consequent reduced visual acuity, these rays are absorbed.

Corneal opacities may interfere with vision by inducing astigmatism, the degree of which is dependent upon the extent, depth, and density of the opacity. It is felt that tattooing may be beneficial in a central, localized cataract where the opacity covers the pupillary area. The diffusion of light, with its consequent loss of vision, may be abolished after the injection of insoluble pigment. Spanyol (16) reported a case in which vision improved from 5/30 to 5/15 after staining a leukoma which extended over the pupil and part of the iris. Csapody (17) reported a case in which vision increased from counting fingers at one meter to 1/10.

CONCLUSIONS

Though not having the importance of those capital operations, such as keratoplasty, which restore vision in selected cases, tattooing of corneal scars may confer marked benefit upon those patients who are not acceptable for the transplant operation. Tattooing may improve visual acuity by reducing the area of an abnormal cornea through which dispersing pencils of light pass in order to obstruct or absorb the annoying peripheral rays. The tattooed surface will also absorb the troublesome intra-ocular pencils of light by reducing the size of the transparent pupillary area. Even though the eye may be blind, tattooing will conceal a conspicuous deformity which may have been most harassing and the cause of somatic and psychic disturbances. These unfortunates should not be encouraged to endure the abuse and misery to which they are predestined.

Attempts to stain the cornea of experimental animals with certain metallic salts were unsuccessful.

The method of permanent pigment injection of corneal scars is described. Three cases are presented.

The authors are indebted to Miss Frances Powe for her assistance in the experiments and the preparation of the manuscript.

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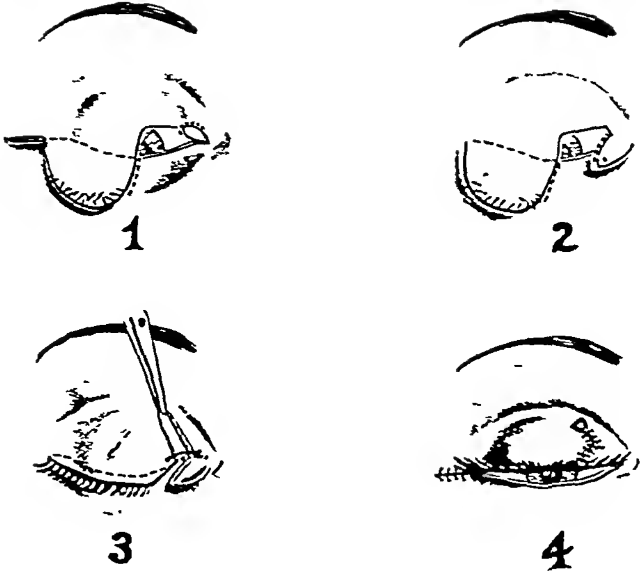

FIG. 2. AUTHORS CASE

(1) Diagrammatic sketch of operative procedure. The external ligament was cut through the skin incision at the outer canthus allowing the lid to be advanced nasalward.
(2) The dotted lines should be extended further to show the entire freshened edge.
(3) Elevation at the apex of the defect pulled the lid to the nasal side and corrected the outward rotation.
(4) Incisions closed with fine silk. The conjunctiva was sutured separately. The small triangle is the site of the conjunctival adhesion and was not closed.

FIG. 3. AUTHORS CASE POST OPERATIVE

Immediate post operative result. Note the small fistula in the inner corner of the left eye.

COLOBOMA OF THE EYELIDS[1]

WILLIAM S. KISKADDEN, M.D. AND MAR W. McGREGOR, M.D.

Los Angeles, California

It is fortunate that the incidence of congenital coloboma of the upper eyelids is relatively rare. The surgical treatment is not always easy and the results, if surgery is inadequate, may result in corneal scarring and impaired vision. Moreover, delay in surgical correction is dangerous since treatment to prevent corneal

FIG. 1. AUTHORS CASE PREOPERATIVE

The tiny island of tissue depicted in figure 2 can be faintly made out in the inner canthus of the left eye. Note the complete relaxation of the right lid.

ulceration in the young infant will often prove inadequate and surgery become not a matter of cosmetic improvement but one of functional and early necessity.

The following case report illustrates the failure of temporizing treatment and the necessity of early reconstruction of an adequate covering for the delicate cornea.

D. H., one of unidentical twins, age one week, was referred to me by Com. G. B. Grey of Corona Naval Hospital. Family and genetic history of negative value. The defects of

[1] Presented at the meeting of the American Association of Plastic Surgeons, Toronto, June 4, 1946.

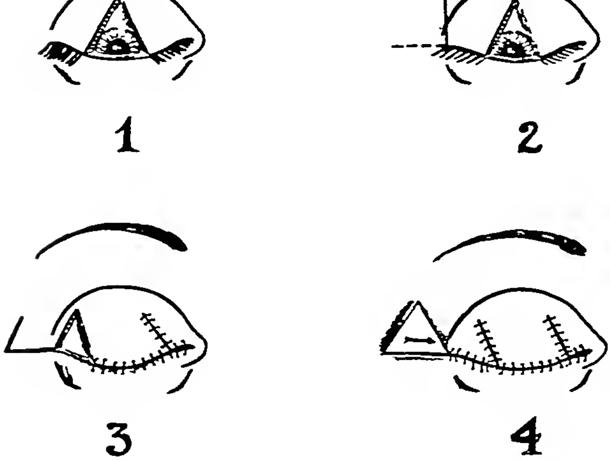

Fig. 6 Method of Falchi

(1) The defect has been converted into a "v" or triangle
(2) Incision made through the full thickness of the upper eyelid extending from the external canthus upward and temporalward, external canthal ligament cut as indicated by the dotted line.
(3) Flap of eyelid moved to the nasal side and original defect closed Flap outlined and elevated on temporal side of eye
(4) Temporal flap moved nasalward and secondary defect closed Small triangular defect remaining closed by free graft

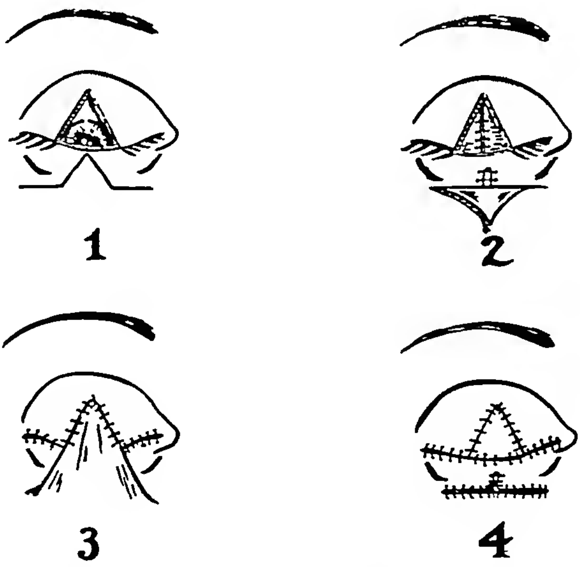

Fig. 7 Method of Wicherkiewicz

(1) Defect is converted into a "v" or triangle A "v" shaped flap is outlined on the lower lid.
(2) Conjunctiva, muscles and tarsal plate have been approximated. The flap has been elevated from the lower lid and reflected downward The bed from which the flap was elevated has been closed.
(3) Flap is attached to the upper lid Eyelids have been sutured together.
(4) Flap detached. Eyelids remain sutured together Area from which the flap was removed closed.

FIG. 4. AUTHORS CASE
Immediate post operative result.

FIG. 5. AUTHORS CASE
10 months post operative.

the eyes are shown in fig. 1. However, the picture does not delineate the small islands of skin and conjunctiva that occupied a small corner of the upper inner canthus. These islands measured not more than $\frac{1}{4}''$ in diameter, but they proved invaluable in the reconstruction (fig. 2). In addition there is a fine filmy attachment of conjunctival tissue extending from the proximal edge of the defect to the eyeball of each eye. This adhesion was not cut at the time of the plastic correction, and as a result, two small holes or fistula of the lids were formed as shown in fig. 3. These fistula have given no trouble and correction has been postponed. At the time of the first examination, we were anxious to study the various methods of repair and referred the family to Dr. J. Lordan who instituted treatment consisting of frequent boric irrigations and application of boric ointment to the eyes. No ulcerations were present at this early date, but gradually over a period of two months there developed some corneal ulceration of both eyes. This occurred despite the intelligent care of the mother, a former nurse. It was decided at this point that surgery was imperative, and at approximately the age of $2\frac{1}{2}$ months the procedure shown in fig. 2 was carried out. The immediate postoperative results are shown in figs. 3 and 4, and a later picture, fig. 5, taken at the age of about two years depicts the late results. The slight corneal scarring present at the time of the first operation has largely absorbed, and we believe will have little permanent effect.

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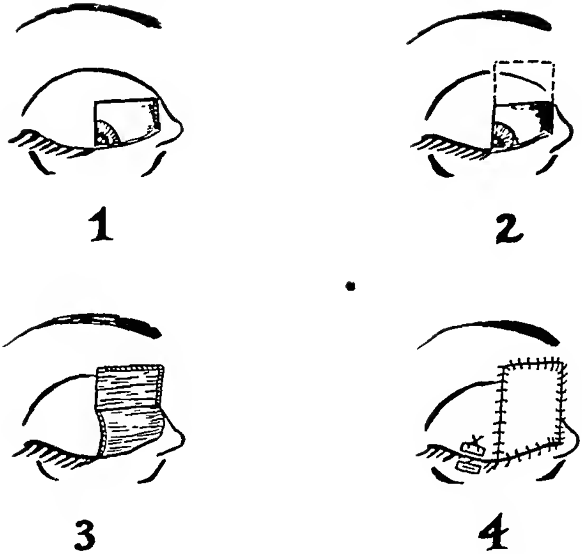


Fig. 8. Method of Peer

(1) The defect has been converted into a rectangle.
(2) Flap is elevated from the lid above the defect.
(3) The flap is turned down, and sutured into position.
(4) A full thickness free graft from the opposite upper lid is sutured over the raw area.

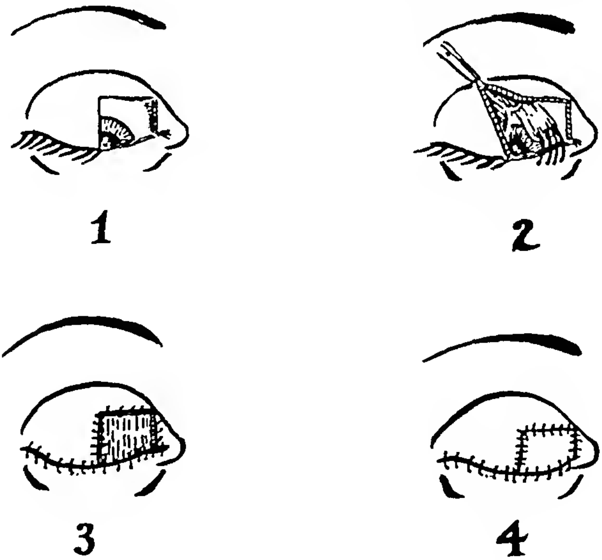
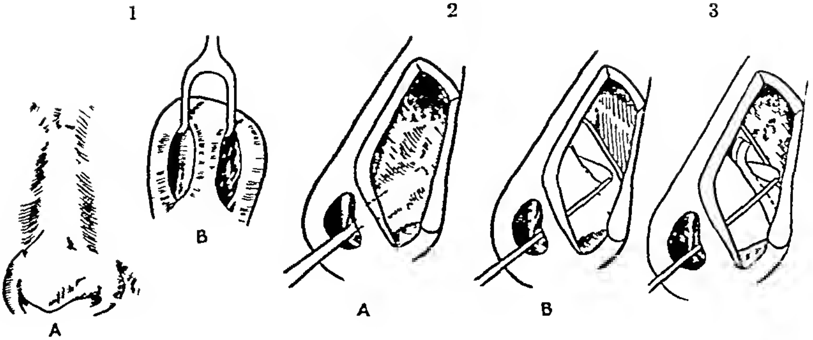


Fig. 9. Method of Hughes

(1) The defect has been converted into a rectangle.
(2) Incision made on the inside of the lid, temporal side of the defect, through the conjunctiva and tarsus. Section of tarsus with attached levator muscle moved nasalward and attached to the lower lid.
(3) Tarsus and levator sutured to edges of defect.
(4) Free full thickness skin graft from other upper lid covering the defect. Eyelids sutured together.



FIGS 1–3

FIG 1

(a) The nasal tip is deviated to one side in the severe type of cartilage deformity due to fracture and/or dislocation of the lower part of the nasal septum

(b) The inferior margin of the quadrilateral cartilage protrudes into one nostril Dotted line shows the line of incision This is usually made at the mucocutaneous junction Careful sharp dissection is required to expose the cartilage at this point because of firmly attached fibrous bands at the lower margin of the septum The mucoperichondrium is elevated on the side of the convexity although the incision in the columella is made on the side opposite the convexity

FIG. 2a

Separation of the mucoperichondrium from the cartilage is first made with a sharp submucous elevator When a freely separating area is reached, a more blunt elevator is used for greater safety and ease It is essential that the mucoperichondrium be elevated to the highest and lowest extremes The superior elevation must extend to a point where the elevator can be seen moving freely beneath the nasal skin from the distal end of the nasal bones to the tip of the nose Likewise, the mucoperichondrium must be elevated inferiorly to its attachment with the vomer Here there are frequently fibrous attachments requiring sharp dissection When this has been accomplished, the mucoperiosteum of the vomer is elevated as far as is necessary or immediately visible This mucoperichondrial separation is usually carried posteriorly to the angle of deflection

FIG 2b

A #15 Bard Parker knife or a small sharp right angled knife is then used to incise the cartilage at the angle of deflection from the ridge of the nose to the vomer Care should be used to be certain that the mucous membrane on the opposite side is not incised It is usually safer to incise part way through the cartilage and complete this step with a sharp elevator

FIG 3

If the angle of deflection is sharp, it is sometimes necessary to remove a ⅛" vertical strip of cartilage just anterior to the angle of deflection to provide better access to the mucoperichondrium on the side opposite the angle of deflection This also permits greater access to any existing posterior deformity

hundred and eleven cases since it was first introduced by Metzenbaum. The results have been uniformly good Throughout the years a few refinements have been added to the originally described technic but the basic principle remains unchanged: namely—restoration of normal function and appearance by the use of the material present.

The technique used is briefly outlined in the legend accompanying the drawings.

RECONSTRUCTION OF THE NASAL SEPTUM[1]

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The subject of this paper might be considered a strictly rhinological problem. The reconstructive surgeon, however, is more frequently consulted about the problem of correcting a nasal septum deformity associated with an external nasal deformity than is the rhinologist. The two deformities should be approached with a comprehensive plan aimed toward functional as well as cosmetic restoration. Most rhinologists, by virtue of their training, give thought only to the correction of the nasal airway by means of a too complete submucous resection or one of its minor modifications. The problem, therefore, belongs in the field of reconstructive surgery, provided that a few basic principles of rhinology are followed.

Septum deformities are innumerable in type and severity. Only those involving the anterior inferior margin of the septum and this type of deformity combined with an external nasal deformity will receive principal consideration in this discussion.

The methods of correction of the anterior inferior margin of the septum are:

(1) Submucous resection.

(2) Resection of the displaced cartilage and replacement by transplanted cartilage support—either hyaline cartilage from another part of the body or by utilization of the resected septal cartilage as a free graft as advocated recently by Peer (1).

(3) Septum reconstruction as was originally outlined by Metzenbaum (2) (3) in 1929.

Septum reconstruction has gained little popularity in spite of modification of the original procedure advocated by Maliniac (4), Seltzer (5), and others. This is perhaps because Metzenbaum's original publication on the subject of "reconstruction of the displaced lower end of the septal cartilage" made it appear like a very formidable procedure.

Since the material is present in most anterior and inferior septal deformities to restore it to normal position and likewise have it render satisfactory support, it seems unwise to fail to utilize such a method of obtaining a positive result when it can be rather easily accomplished.

It is rarely necessary to remove the septal cartilage completely and replace it as a free graft or utilize cartilage from elsewhere in the body for support of the columella and tip.

Injudicious use of a submucous resection is only to be condemned and is a grave surgical error.

The author and his preceptor have reconstructed the nasal septum in three

[1] Presented at the Fifteenth Annual Meeting of the American Society of Plastic and Reconstructive Surgery, Kansas City, Mo., November 15, 1946.

FIG. 11

A. Preoperative B. Postoperative C. Preoperative D. Postoperative

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FIG. 9

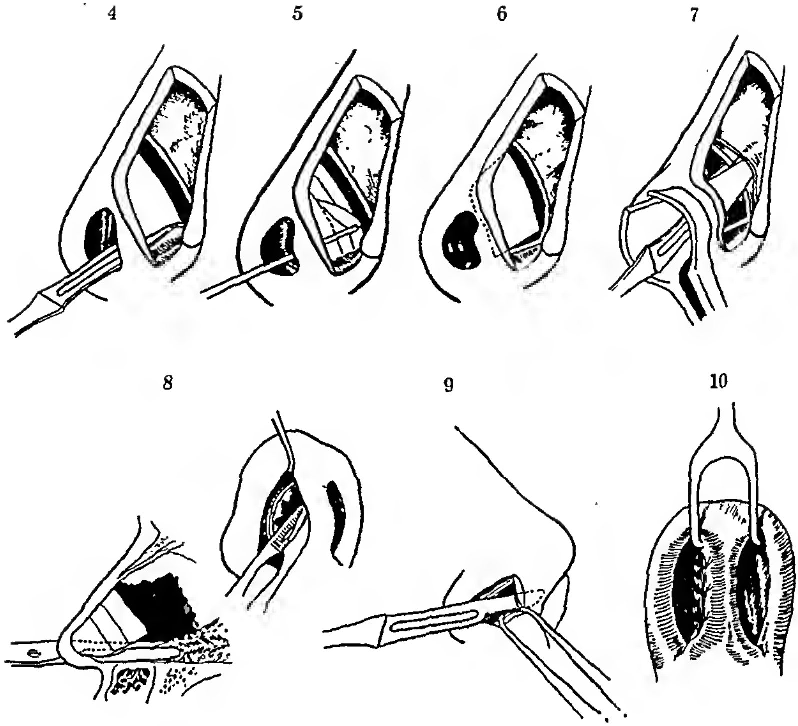
A bed is dissected in the columella for the reception of the dislocated anterior inferior edge of the cartilage.

FIG. 10

The incision is approximated with a suture material of the surgeon's choice. Light packing is then inserted in each side of the nose. This is removed in 24 to 48 hours.

The only postoperative care necessary is gentle daily cleaning of the nose with a suction pipette until the patient can be permitted to manage his own nasal hygiene.

The sutures are removed in 7 to 10 days.



Figs. 4–10

Fig. 4

A #15 Bard Parker knife is then used to incise through the cartilage along its inferior margin. At this point, or perhaps later in the procedure, it may be necessary to remove a strip of cartilage from the inferior margin at its articulation with the vomer. The necessity for doing this depends upon the amount of cartilage present, the height of the vomer ridge upon which it will eventually rest and whether it is necessary to elevate the cartilaginous bridge of the nose.

Fig. 5

If there is any curvature of the anterior piece of cartilage this curvature can be corrected by "lobster tailing" or cross-hatching the cartilage with a right angle knife. The incisions must always be through to the mucoperichondrium of the opposite side and be complete from above downward in order to eliminate any tendency of the cartilage to spring to former position.

Fig. 6

The anterior block of quadrilateral cartilage must now lie in the midline position—*without traction* or *tendency to spring into its former position*. This requirement is most essential for a successful end result. If there is any tendency for the cartilage to spring to its former position, all points of attachment which were assumed severed should be rechecked. It is necessary occasionally to sever the attachment of the medial crus of the tip cartilage and the triangular cartilage from the septum, just as is done in a revision of the tip cartilages, using either straight scissors or a scalpel.

Fig. 7

Any deformity of the septum posterior to the freed anterior cartilage can now be resected, leaving the vomer undisturbed.

Fig. 8

The vomer has frequently been fractured to an angulated position. It is desirable to utilize the vomer as a support upon which to rest the anterior piece of cartilage. Where feasible, the vomer is fractured and rotated to the midline position. It must remain here without tendency to return to its former location. It is usually necessary to elevate the periosteum from one side only. It can often be fractured into midline position by the pressure created by opening a long blade nasal speculum. Any type of long bladed blunt forceps can be used extra-mucosally if necessary. Spurs, sharp angles, etc. on the vomer are handled as indicated.

Reconstruction of the nasal septum can be performed together with an operation for reshaping the nasal framework. It has been our custom to use the combined procedure when there is not a full length septum deformity present. When the latter exists, we elect to correct the septum deformity first and then perform the external nasal surgery at a later date.

When a full length septum deformity exists and the anterior inferior margin of the septum has been displaced, the front portion of the septum is reconstructed and the deformity in the posterior two-thirds of the nose is resected in the classical manner.

Reconstruction of the nasal septum permits the correction of any type of septum deformity on a child at any age. The old adage, "Wait until the nose has attained maximum growth," is a statement not supported by our experience.

The criteria of an operation which will assure a satisfactory end result are:

(1) The reconstructed cartilage must rest in the midline position without the slightest tendency toward deviation to either side.

(2) The tip of the nose must therefore be in the midline position.

(3) The ridge of the nose must not be lowered. (Occasionally it can be raised if necessary.)

(4) The nostrils must be symmetrical.

(5) The nasal airway must be re-established equally on both sides.

REFERENCES

(1) Peer, L. A.: Arch. Otolaryng., 42: 384 (Nov.-Dec.) 1945.
(2) Metzenbaum, M.: Arch. Otolaryng., 9: 282 (March) 1929.
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(4) Maliniac, J. W.: Arch. Otolaryng., 42: 131 (August) 1945.
(5) Seltzer, A. P.: Arch. Otolaryng., 40: 433 (Dec.) 1944.

A B

Fig 12

A Preoperative B Postoperative

A B

Fig. 13

A. Preoperative B. Postoperative

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A B

FIG 12

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A B

FIG. 13

A. Preoperative B. Postoperative

the head away from the affected side the lateral fibers of the platysma stood out under the skin; this was not so when applied to the unaffected side. The shortening of the platysma muscle prevents the early correction of the deformity and is a causative factor in the facial asymmetry, which is but natural when we consider that the platysma muscle arises from the fascia covering the upper part of the pectoral and the deltoid muscles, the fibers proceeding upward and inward along the side of the neck. The anterior fibers interlace with the fibers of the opposite side; the posterior fibers pass over the mandible, some of them being attached to the bone, others pass on to be inserted into the skin and subcutaneous tissue of the lower part of the face, and many of these blend with the muscles about the angle and lower part of the mouth. Some fibers can be traced to the zygomatic muscles or to the margin of the orbicularis oris.

Unless due attention is given this muscle with its vast insertion into the structures of the face, postoperative immobilization and after treatment will be greatly prolonged. The flattening of the face, which is more noticeable after tenotomy of the sternomastoid muscle, persists, unless its causative factor is removed.

It was evident if the platysma played such an important part in the causation in the deformity, that in order to properly correct it some additional measures would have to be undertaken dealing directly with the platysma in addition to the operative procedures on the sternomastoid muscle itself. Consequently, we devised the following procedure which we have practiced since 1913:

A one to one and one-half inch incision is made above the clavicle and in line with the sternomastoid muscle and between its sternal and clavicular origins. The sternal portion of the muscle is hooked up with an aneurium needle and is clamped with a hemostat. A one-half to three-fourths inch cross-section is removed. This is also carried out on the clavicular portion of the tendon. Originally we slit the sheath before removing the tendon tissue and then cut the sheath transversely without removing a section of it. This we find unnecessary as the tendon unites without the aid of its sheath. All contracted bands of fascia are severed.

We now come to the important feature of the operation. An assistant is instructed to pull down upon the arm of the affected side while the anesthetist forces the head in the opposite direction. In very severe cases the lateral fibers of the platysma are cut transversely to the extent of about one inch. Generally it is sufficient to relieve this tension by freeing the muscle along its external border from the skin by blunt dissection. Either severing of the muscle or freeing it from the skin is done through the original skin incision, but care must be taken to avoid damaging the external jugular vein, which normally is beneath the platysma, descending in a line from the angle of the jaw to the middle of the clavicle but which is occasionally superficial to the platysma, through part of its course, making it advisable to locate the vein before beginning the dissection.

Following closure of the wound, a dressing is applied with care in order that the desired end be attained, namely that of holding the head in an over corrected position until the stitches are removed at the end of eight or ten days.

THE RÔLE OF THE PLATYSMA MUSCLE IN TORTICOLLIS DEFORMITY[1]

A. D. LaFERTÉ, M.D.

Detroit, Michigan

In our early endeavors to eliminate the plaster dressing following the operation for the correction of torticollis, we were impressed by the contraction of the platysma muscle of the affected side when put under tension, and we were able to demonstrate that proper attention to this condition facilitated the correction of the deformity without rigid fixation of the head following operation.

OPERATIVE TREATMENT

The operation generally practiced is the division of the affected sternomastoid muscle either at its origins or insertion, the head is placed in over correction and a plaster-of-Paris cast is applied. The cast is left on from two to six months or is removed at the end of ten or fourteen days and some form of brace or collar is applied which in turn remains on for some months.

The application of a plaster cast which includes the head, with the patient under an anesthetic, is a rather difficult task, as the anesthetist with his necessary equipment interferes with the work. If the anesthetic be discontiued prior to the application of the cast the patient probably becomes nauseated and the vomitus gets into the cast leaving a permanently ill-smelling dressing. It is also difficult to keep food and other objects from finding their way under the cast.

In order to overcome these unpleasant features and to eliminate the use of any fixation material, a new operation was devised.

Our *first attempts* at discarding the plaster and braces were not very successful, because, having severed the tendon through an incision above and parallel to the clavicle, we found on attempting to manipulate the head on the eighth or tenth postoperative day, that the line of tension was at a right angle to the incision, and because of subcutaneous adhesions the procedure was rendered painful and consequently inefficient. This difficulty was overcome by making a one to one and a half inch vertical incision above the clavicle and between the two origins of the sternomastoid muscle. The line of tension now being in line with the muscle, we were able to give painless, passive movements on the eighth or tenth day, and also in using the vertical incision, not only did we lessen the tension but we believe that there will be less tendency to keloid formation resulting from the irritation of the exercises. Our next difficulty arose at about the end of the third week, at which time there was a tendency to recurrence of the faulty position and the movements were restricted and painful. *This we attributed* to the too early union of the severed ends of the tendons. It was also at this time that we noticed that while pulling on the arm and forcing

[1] From the Department of Orthopedic Surgery, Wayne University College of Medicine, Detroit.

Fig. 2. Second Pad

Fig. 3. Third Pad

The dressing is applied as follows: The patient is moved over the head of the table so that we can bandage around the upper trunk without difficulty. The head is held in the fully overcorrected position and an ordinary abdominal cotton pad covered with gauze, measuring approximately 9 × 12 inches, is placed over the upper portion of the chest and the side of the face as shown in figure 1. Next a pad of the same size is rolled and placed transversely to the first in such a position that it passes under the chin, thus holding the chin up from the shoulder of the affected side, as shown in figure 2. A third pad (fig. 3), is placed in the same position as pad number one. This serves to hold pad number two in place.

Fig. 1. First Pad

A fourth pad is rolled and placed on the back of the head, neck and shoulders in a line with the body, in such a way that, were the head to attempt to return to the faulty position, it would be necessary for it to roll over this pad. In other words, the pad acts as a wedge between the patient's head and the bed. This is shown in figure 4. A plentiful three inch gauze or flannel bandage is applied to hold the pads in place (fig. 5), and the patient is returned to bed to remain until the stitches are removed, when all dressings are discarded.

Exercises are now given for five minutes, twice each day. This is done in order to prevent the formation of adhesions and also to demonstrate to the patient that he now has full range of movement of the head. The exercises are at first passive, then active and passive. However, in spite of this, we have noticed

in the older patients that there is a tendency for them to assume the previous faulty position of the head, and it occurred to us that possibly they assumed this old position of the head in order to better focus the eyes, and that there was necessary a certain period of time to elapse before the ocular muscles readjusted themselves to the normal position of the head. We discussed this with one of our ophthalmological friends and he offers this as a possible explanation.

Among the factors to be considered after the operation for wry neck which may be slow in straightening, are the habits developed by the eye muscles during the period of head tilting. Head tilting is a symptom produced by difficulties of eye muscles as well as of muscles of the neck. It has happened that neck muscles have been operated on when the trouble was with the eye muscles. If

Fig 6 Right Torticollis, before Operation

the head is turned as in wry neck the eyes cannot look straight ahead, with the visual axis of each eye parallel, without marked tension on the eye muscles. A diplopia or double-vision is produced. This cannot be borne well comfortably. It becomes a habit of the eyes under such circumstances for one eye to suppress. That is, the individual will put out of his consciousness all mental perception from one eye. If, therefore, he really sees with only one eye there will be no double-vision and he will be comfortable.

Now if it happens that before the operation for wry neck, that neither eye has suppressed and that the patient by muscle effort has established a new and comfortable, though, abnormal alignment of the muscles to suit the position of head tilt, this abnormal, comfortable muscle balance will be disturbed when the neck muscles are operated on and the head is placed back in normal position.

FIG. 4 FOURTH PAD

FIG. 5. COMPLETED DRESSING

The cure may be worse than the disease. At least, under the circumstances the patient should not be urged too much to straighten his head up. He may gradually make a perfect adjustment, but give him time. If he does not respond in reasonable time an opthalmologist, who is thoroughly familiar with treatment of muscle eye defects should be consulted. Through orthoptic exercises much more rapid adjustment may be made. Cases in older people of years standing may require the wearing of prisms after operation for wry neck or may even require operation of the eye muscles.

SUMMARY

Torticollis is a very disfiguring deformity. Many types of operations have been devised for correction of the congenital type and it is the congenital type with which this paper is primarily interested. The importance of the platysma and the part it plays in the deformity has been neglected, we think. The operation which has been suggested takes into consideration the part the platysma plays in the deformity. We have described a vertical type of incision of the sternomastoid attachments which we think obviates some of the difficulties of the horizonal incision. It is suggested, also, that the removal of a section of the tendon of the sternocleidomastoid muscle aids in the correction of the deformity. The use of cotton pads in the postoperative dressing, thereby eliminating the more cumbersome and somewhat objectionable plaster dressing, adds considerably to the comfort of the patient and it has been found possible that by carrying out the procedures as suggested in this type of operation, complete elimination of all fixation and supportive dressings may be done at the end of eight to ten days when active and passive movements of the neck are instituted.

We have also called attention to the importance of giving due consideration to the eyes and their readjustments following the correction of the deformity of torticollis and the return of the head to the normal position.

Fig. 7. Right Torticollis, Five Months after Operation

Fig. 8. Right Torticollis, Five Months after Operation

Therefore, the patient may have to hold the head in the old position in order to have the eyes comfortable. Otherwise, there may be headaches, diplopia and possibly nausea.

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FIG. 7. RIGHT TORTICOLLIS, FIVE MONTHS AFTER OPERATION

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November 28th, the skin tube was irrigated with a mild antiseptic solution and was found to be patulous throughout its length. Care was taken that the healing wound should not become wet by the urine from the nearby ureteral sinus. Some difficulty was encountered in keeping it dry but it has remained healed throughout its length.

The delays between operations were due chiefly to illnesses of other members of the patient's family and to other uncontrollable circumstances. The length of the tube became somewhat shorter because of the long period of waiting and also because of inability to keep the urine away from the upper end throughout the waiting period. Therefore, on January 27, 1944, the tube was lengthened to beyond the midline below and to within one and one-half inches of the ureteral stoma above. The incisions were made just within the previous scars. It was necessary to cross an old perpendicular scar line, at the lower end near the median line. This did not interfere with healing or with the formation of the tube. There was delay again due to sickness in the patient's family.

On June 19, 1945, Dr. T. G. McDougall made a pylogram through the ureterostomy sinus. It "showed what appears to be a ureterostomy with no kink in the ureter but dilatation at least one plus of the renal pelvis."

August 16, 1945, under spinal anaesthesia, Dr. McDougall and I implanted the lower end of the skin tube into the bladder. The wound healed nicely and subsequently fluid was passed easily through the tube into the bladder from which it was voided.

On September 11, 1945, twenty-six days after the implantation, cystoscopy by Dr. McDougall "showed a slight partially inflammatory reaction about the implanted tube and while a definite bud is not seen in the bladder, there is a lip of epithelial tissue, probably lying on the upper margin of the ostium. This area is clean and fluid can be seen coming through the ostium. An attempt was made to pass a catheter from the upper opening into the bladder, but this met an obstruction in the lower end of the tube, . . . No attempt was made to pass a catheter retrograde."

October 26. The patient has been unable to get water through the tube for several days. I was unable to get any through. A long cotton tipped silver probe removed a small ball of epithelial cells and a few days later dislodged some dark metallic substance, probably precipitated permanganate solution which had been used as irrigating fluid. Several days later, November 9, fluid passed freely through the tube to the bladder and the patient voided a small mass, a dark flakey metallic substance $\frac{1}{8}$ inch long by $\frac{1}{16}$ inch wide and very thin. On December 5th fluid passed freely.

December 10, 1945, the upper end of the tube was connected to the ureterostomy opening also under local anaesthetic. On the second post-operative day four ounces of urine entered the bladder while the kidney catheter was yet in place and the patient voided twice the following day. On the fourth day the catheter was removed. Since then urine has entered the bladder as fast as 1100 cc. in twenty-four hours.

It is impossible to give conclusions at this time but certain reports can be made including the details of the operative procedures. Delays were encountered and difficulties were met which experience has shown may be obviated. That anastomosis of the ureter to the urinary bladder by means of a skin tube and its continuous functioning is feasible has been proved. The entire anastomosis should be accomplished in three months or less depending on the length of time between operations. Three steps are necessary, perhaps four, in some patients. They are: making the tube, implanting the lower end into the bladder and connecting the upper end to the ureteral orifice and in some patients perhaps closing any remaining small sinus. It is not necessary to detail here the obstacles which had to be overcome in this first case. The experience herewith noted will make their repetition unnecessary. It might be well to state, however, that should a

ANASTOMOSIS BETWEEN THE URETER AND URINARY BLADDER BY MEANS OF A SUBCUTANEOUS SKIN TUBE*

ADALBERT G. BETTMAN, M.D.

Portland, Oregon

Re-establishment of the urinary flow from a ureterostomy or nephrostomy fistula to the bladder has been accomplished. Herewith is presented a preliminary report of an original procedure to bring about this result and thereby alleviate a distressing condition.

On July 14, 1942, Mrs. S. E., age 50 years was seen in the office of the late Dr. Franklin P. Johnson. She had lost her right kidney in 1926 on account of stones and early in 1942 developed an acute obstruction of the left ureter necessitating an emergency operation in which Dr. Johnson brought the ureter out to the skin of the left loin. The patient was very much disconcerted by the necessity of wearing and caring for the catheter and other apparatus that drained the urine into a bag on the thigh, and wished that something might be done to overcome the condition.

The literature was of no value so far as suggestions were concerned. Efforts have been made to divert the urinary stream, particularly the operation devised by the late Dr. Robert C. Coffey, in which the ureter is implanted into the large bowel. This operation was not possible for the present patient. It was necessary, therefore, to devise an operation to meet the conditions. The one suggestion in the literature was that of reconstructing the oesophagus by use of a skin tube.

The following operative procedures were then proposed: 1. Prepare a skin tube on the left loin from just below the ureterostomy opening to the median line above the pubes. 2. Implant the lower end of the skin tube into the bladder. 3. Connect the upper end of the skin tube to the ureteral fistula orifice.

The proposed plans of operation were explained to the patient. She was informed that this was a new procedure, one that had never been carried out before, and that while it was experimental, it was based on good surgical principles.

On July 22, 1942, under local anaesthetic the first operation was done. It should be stated that although the urine had been flowing over it several months, the skin showed no evidence of irritation. Also, fortunately, the skin of the abdomen and loin were entirely devoid of hair, otherwise a different procedure would have been carried out, as will be explained later.

The scar of the previous operation was narrow and lay partly in and partly just anterior to the fold of the thigh on the lower abdomen. The present incisions were made somewhat anterior to and above this scar.

Assisted by Dr. Johnson a skin lined tube was made from a strip of skin one inch wide sutured over a catheter which was left in place. The tube later opened throughout its length.

On October 6, 1942, under local anaesthetic as before, the tube was again closed over a catheter making the incisions just within the previous scars. Thus the circumference of the tube was slightly under one inch. This time the catheter was removed after about thirty hours. It came out easily. The patient left the hospital on the eighth day, the tube being nicely healed throughout its length except for three openings each about the diameter of a broom straw. These were closed and remained closed.

* Read before the Annual Meeting of the American Society of Plastic and Reconstructive Surgery, Kansas City, Mo., November 16, 1946.

sutures should not be placed in the skin but in the subcutaneous tissue so as to bring the deep layers of the skin together covered by a layer of fat. This line of union must be united meticuously water tight. As thick a layer of fat as possible is placed over the suture line. These sutures may be of 5-0 chromic gut. Thus a skin lines tube will have been provided. The superficial skin is now sutured also bringing over a layer of fat as thick as possible. The outer skin sutures may be of horsehair and these edges are everted.

In making the skin flap as above indicated, it is assumed, of course, that the skin does not bear hair. Fortunately, such was the case with my patient. When the skin is hair-bearing an entirely different procedure will have to be carried out. Either one of two methods may be used.

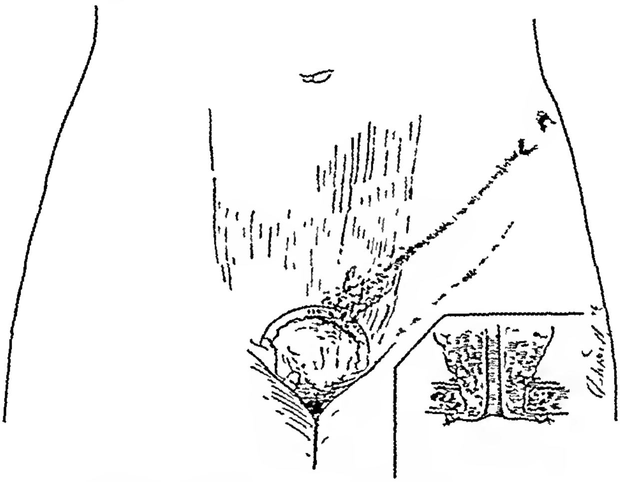


FIG. 2. DIAGRAMMATIC REPRESENTATION OF THE IMPLANTATION OF THE SKIN TUBE UNDER THE RECTUS MUSCLE AND INTO THE BLADDER

The insert shows the details of the method of suturing the end of the tube into the bladder.

1. Make a full length incision through the skin rather deeply into the fat, apply a long thin split skin graft from the thigh or elsewhere and implant as an ordinary split skin graft. Later this grafted area may be used as the lining of the tube. Or,

2. Make a long tunnel under the skin, in the fat, one that will take, let us say, a number twenty catheter wrapped around with a split thickness skin graft and imbed these into the tunnel in the desired position.

Even though the abdomen and loin are devoid of hair, all patients have hair on the pubic region. For this reason, it is necessary to swing the lower portion of the incisions far enough forward and upward to avoid this hair-bearing region. It is necessary also to extend the parallel incisions slightly beyond the median line to get sufficient length. As the anastomosis of the blood vessels across the median line is not over abundant the incisions should not extend too far.

portion of the tube not heal as anticipated primarily, the sinus may be closed with certainty that a continuous tube will result.

The necessary operations are herewith described: All operations except the implantation into the bladder were done under local anaesthetic consisting of procaine 1 per cent with adrenalin 1:100,000 and preceded by dilaudid Gr. 1/32, atropine sulphate Gr. 1/150 hypodermically and amytal Gr. 1½ by mouth, all one-half hour pre-surgery.

First step. The primary incisions are planned so that the tube will be sufficiently long that the lower end will reach into the bladder when the second step has been accomplished and that its lumen is large enough to carry the urine. Also, there must be no kinking or angulation at any point for there is no muscle to

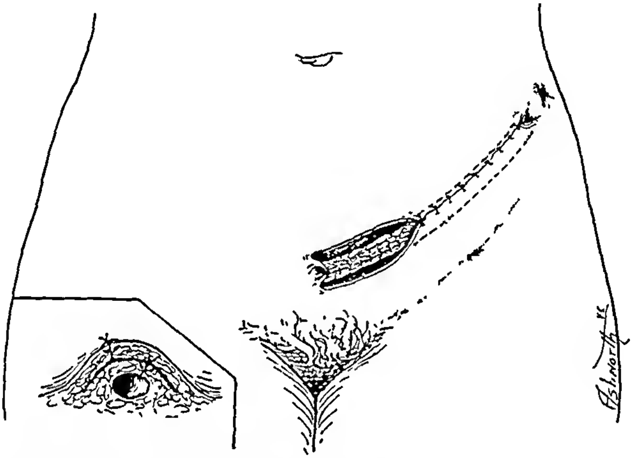


FIG. 1. DIAGRAMMATIC REPRESENTATION OF THE METHOD OF MAKING THE SKIN-LINED TUBE IN THE LOIN

The insert shows cross section of the method of suture.

carry the urine along. The urinary flow will be dependent on gravity and on the effect of the respiratory movements as they alternately compress and relax the kidney pelvis. That the respiratory movements have such action was noted during the operative procedures.

Two parallel incisions are made slightly over one inch apart for the required length and in the correct location. The incisions go through the skin and the edges are undercut, one slightly, the other somewhat more, so that the longer edge may be pulled either forward or backward as desired and the two edges sutured together as a tube with the skin surface inside. The outer edges are then similarly undercut, particularly on the opposite edge from the first so that the two suture lines will be staggered and will not lie one directly upon the other. Whether or not the suturing is done over a catheter seems of little consequence, however if used it probably should immediately or shortly be removed. The

thin and the overlying skin surface must be removed carefully so as not to open into the lumen of the tube.

The bladder is now exposed and an incision made through its anterior wall. The external border of the external rectus muscle is separated from its attachment in this region. The free end of the tube with its attached fat is passed beneath the rectus sheath and muscle and is implanted into the bladder at its upper lateral corner through a small incised wound and sutured in place. The button of skin about the lower end of the tube is laid flush against the bladder wall. Additional sutures are applied along the length of the fat about the tube to hold it in position and to prevent kinking and pulling. The bladder is closed.

FIG. 4. PHOTOGRAPH

A. Ureteral outlet in the left loin leading from kidney. Surrounding area moistened but not mascerated or irritated after four years of urine running over it.

B. Upper orifice of skin-lined substitute ureter.

C. Adherent scar of original ureter operation. The scar of the skin tube operation is located above this scar and can be faintly seen.

Sutures are placed in the sheath of the rectus muscle to prevent herniation of the intestines. The wound is closed after dusting in one of the sulphonamides and Penrose drains are placed above and below the bladder. The wound having healed the patency of the tube is tested by syringing fluid through it into the bladder.

From the time of the first operation, or perhaps even before, the bladder should be irrigated from time to time so that its capacity may be increased by adding to the volume of fluid injected each time. A capacity of eight ounces is desirable but not imperative.

Third step. The tube being satisfactorily patent throughout its length as indicated by the ease with which fluid may be syringed through it into the

When satisfactory healing has taken place and the tube has had time to accommodate itself to the new conditions, the second operation is done. The patient continues to wear her usual catheter in the ureter and every effort must be made to keep the urine away from the healing wound.

Should there be a break in the continuity of the skin tube it must, of course, be remedied before the next operation. In closing such a perforation, naturally, both layers must be closed. As stated before, the deeper layer must be definitely inverted and the outer one pulled across, providing a layer of fat between them and having the suture lines staggered.

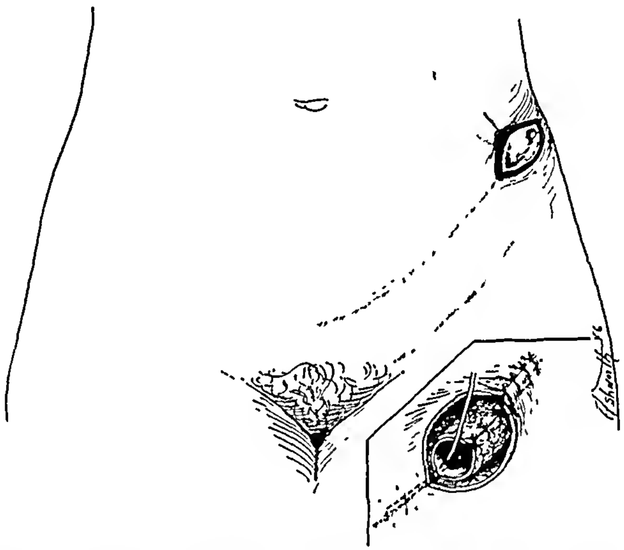


FIG. 3. SHOWS THE FINAL CLOSURE OF THE TUBE TO THE URETERAL SINUS
The insert shows the details of the closure. The probe is in the lumen of the tube.

When the patient has a nephrostomy instead of a ureterostomy another difficulty may present. The ostium may tend to close when the catheter has been removed. This may be prevented by placing split skin grafts on or in the non-epithelized surface. Keeping the surface dry during the operation and during healing will then be of major importance in obtaining a take. This may be accomplished as described under the third step.

Second step. An incision is made about the lower orifice of the tube including a small circle of skin. The tube is then freed for its lower three inches more or less, in such a manner that there is a large fat base, say one and one-half inches broad, to provide blood supply to the now freed portion of the tube and to prevent kinking. This fat layer which surrounds the lower portion of the tube includes the full thickness of the abdominal fat or a major portion of it as it encircles the tube on three sides. On the superficial surface the fat will, of course, be quite

RECONSTRUCTION OF THE COLUMELLA

SAMUEL SALINGER, M.D.

Chicago, Illinois

Total loss of the columella may result from infection, trauma, syphilis or injudicious surgery. The condition is not very common but when it occurs, offers a problem in reconstruction because of the necessity of supplying a thick enough mass of skin to offer some support to the sagging tip. Numerous operations proposed in the older works in surgery in most cases obtained the skin from the nasolabial fold or employed tissues from the lip. There are some instances in which the patient wishes to avoid a scar on the face or lip and in these cases it is necessary to bring a tube flap up from a less conspicuous part of the body.

Havens (1), in a recent article, showed a good result which was obtained by waltzing a tube flap from the submental region. This was so similar to a procedure which I have employed in three cases that I am presenting them herewith. In these cases the tube was taken from the acromio-pectoral region and migrated to the region of the angle of the jaw and from there either directly to the region of the philtrum or after thinning, to the naso-labial angle.

The procedure is a rather lengthy one since it requires three or four operations, but it does obviate the scar on the face to which most patients object. The only stage that incapacitates the patient is the one in which the tube is attached to the angle of the jaw since this requires more or less fixation of the head. However, in the other stages the tube can be covered with a small dressing which does not interfere with the patient's usual occupation.

The scar at the angle of the jaw is scarcely noticeable after a few weeks and the site of implantation in the naso-labial fold can hardly be seen even on close inspection. The accompanying illustrations show how this can be accomplished without the elevation of a flap.

The entire procedure may be shortened considerably if the patient is willing to submit to having the tube constructed from the neck paralleling the sterno-mastoid. Also, the procedure outlined by Havens may yield an inconspicuous scar particularly if the patient has a redundancy of skin and fat in the submental region as would be the case in middle aged or elderly patients.

In the three cases herewith submitted it was not necessary to stiffen the new columella with cartilage since the sagging of the tip was not very marked. However, in one case the collapse of the entire cartilaginous bridge was so marked that a cartilage implant will be required.

Experience has taught me that it is far safer to plant the tube into the region of the columellar base rather than the tip since the circulation here is much more abundant. Besides, traction caused by the weight of the tube when attached to the tip is difficult to overcome before union has taken place. Once the tube has grown into the columellar base, the required length can be measured more

bladder and the solidity of the healed wounds assured, an ellipitcal incision is made through the skin so located as to include the upper end of the tube and the presenting funnel of the ureteral sinus. This skin flap should be made slightly wider than the lumen of the tube so as to give somewhat of an ampulla at this point. This will allow easier approach to the kidney should this ever become necessary. The edges of the skin are undercut as they were for the original tube and are closed in a similar manner. The catheter may be replaced before final closure and the wound must be kept free of urine during the operation. This latter is accomplished easily by applying the free end of an antrum suction tip just within the sinus. When the inner skin layer is closed and the catheter in place, gentle suction is applied to its free end. The inner skin is closed tightly about the catheter and the outer skin covering is closed in a similar manner. Experience may prove however that the skin tube may be tightly closed throughout its length without the catheter or with a suction provided Southey tube in place.

While healing is taking place it will be found that a little urine will trickle around the catheter and down the tube into the bladder. The removal of the catheter, if one has been used, should complete the operation as this remaining exit of urine will close automatically. Should it not close by itself in a reasonable time it may be closed in a water tight manner surgically.

The attention of the patient should be called to the advisability of not lying on the subcutaneous tube and thereby closing its lumen.

This report is based on one case but the feasibility of the operation has been proven as urine has entered the bladder to be voided normally and the skin has shown no irritation or maceration reaction of any kind over a period of several years. Carrying out details as here indicated, will assure a successful result in a minimum time.

629 Medical Arts Building.

6

7

8

9

Figs. 6, 7, 8 and 9 show two other cases similarly treated. Asymmetrical position of columella in figure 9 corrected later (not shown).

1

2

3

4

5

Figs 1 to 5 show successive stages in waltzing the tube to avoid scar on the face or neck.

INKING PENS FOR SKIN MARKING IN PLASTIC SURGERY

JACK ALLAN WEISS, M.D.

Chicago, Ill.

The present methods of marking the skin for precise incisions in various types of plastic surgery are largely unsatisfactory. The customary use of a tooth-pick or a hypodermic needle dipped in a marking fluid results in irregular or smeared lines of varying width.

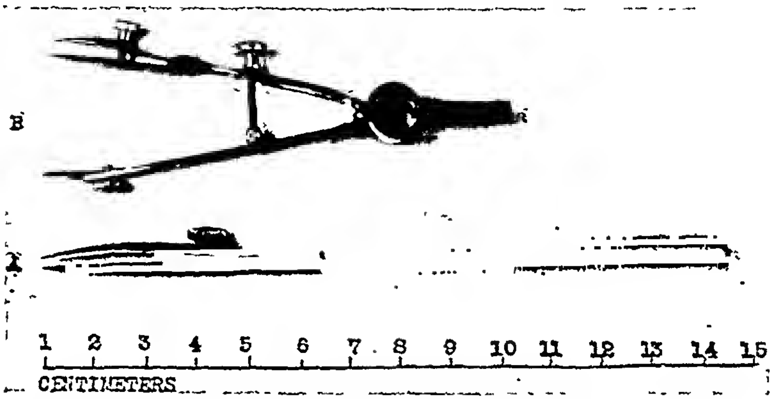
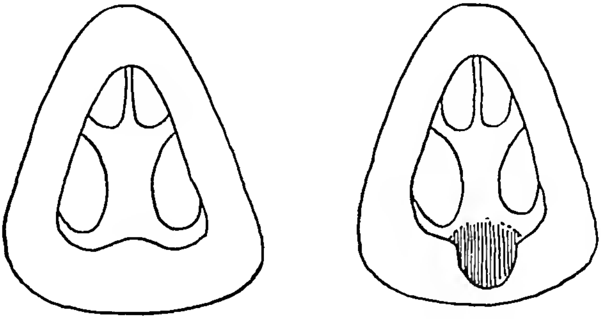


FIG. 1. INKING PENS FOR MARKING SKIN
A, ruling pen for straight or dotted lines; *B*, bow (caliper-type) pen for circular or arc incisions, measuring intervals, etc.

For accurate marking we have employed a ruling pen of the type used by draftsmen. The straight pen has an aluminum handle and steel blades. (fig. 1, *A*). The points may be adjusted by the side screw to make any desired width of line. Methylene blue, brilliant green, mercurochrome, etc., may be used as a marking solution. The pen may be dipped or the fluid placed between the points with a medicine dropper. Excess fluid should be wiped off the outside of the blades; the surface to be marked should be entirely dry to avoid smearing. Precise lines of uniform width may be drawn, or a series of dots made if desired. A single dip is sufficient for all ordinary purposes.

The bow (caliper-type) pen is useful to delineate circular or arc incisions; to mark accurate intervals between two paralell incisions; to measure the incision at the site receiving the transplanted end of a pedicle graft; or to match dimensions of the donor and recipient areas in skin transplants (fig. 1, *B*). A size larger than the one illustrated is available.

Sterilization of the pens may be effected by the usual solutions: alcohol, zephiran, etc. Their use facilitates skin marking in plastic, reconstructive or other surgical procedures.



10.
FIG. 10. FLAP TURNED DOWN IN FLOOR OF VESTIBULE TO RECEIVE THE TUBE

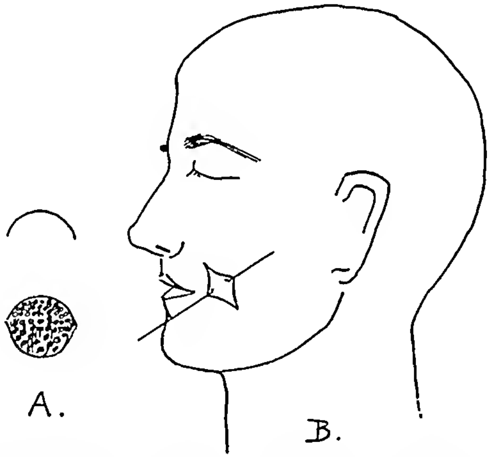


FIG. 11. A. Semicircular flap turned down to received transferred tube. B. Spread incision in naso-labial fold which can be closed without leaving conspicuous scar.

accurately and will necessitate but little suturing for implantation into the tip. Thus unnecessary suture marks in this conspicuous region will be avoided.

REFERENCE

(1) HAVENS, FRED Z.: Reconstruction of the columella nose: a method advantageous for the female patient. S. Clin. N. A. (Mayo No.), 877–79, Aug. 1945.

American Board of Otolaryngology, Charter Member.
American Board of Plastic Surgery, Licentiate.

THOMAS EDWARD CARMODY, M D

PUBLICATIONS

Chapter on Plastic Surgery, Diseases of Nose and Throat, Jackson and Coates, 1929.

THOMAS EDWARD CARMODY, M.D.

May 22, 1875–August 30, 1946

BIOGRAPHIC OUTLINES[1]

Born in Shiawassee County, Michigan, son of Thomas and Mary Ann Carmody, of Irish parentage. His early life was spent in Owosso, Michigan, where he graduated from the high school.

Graduated from University of Michigan Dental School, D.D.S. 1897, D.D.Sc., 1908.

Denver and Gross College of Medicine, M.D., 1903.

Professor of Bacteriology and Histology, University of Denver Dental College, 1898–1905.

Professor of Oral Surgery and Rhinology, University of Denver Dental College, 1905–1932.

Assistant in Laryngology and Otology, University of Colorado Medical School, 1905–1913.

Chief of Otolaryngology, Child Research Council, Research Department, University of Colorado Medical School, 1928–1936.

MEMBERSHIPS

American College of Surgeons, 1913.

American College of Dentists, 1929.

International College of Surgeons, 1941.

Denver County Medical, Secretary 1904, President, 1923.

Denver Dental Society, President, 1907.

Colorado Otolaryngological Society, First President.

Colorado Society for Crippled Children, First President.

American Academy of Opthalmology and Otolaryngology, President, 1923.

American Bronchoesophagological Society, 1930.

American Laryngological, Rhinological and Otological Society, President, 1936.

American Laryngological Association, President 1941.

American Otological Association.

American Society of Oral and Plastic Surgeons.

American Society of Plastic and Reconstructive Surgery.

American Medical Association, Chairman of the Section on Otolaryngology, 1931.

Member of the first International Otolaryngological Congress, Copenhagen, Denmark, 1929.

Member of Board of Directors National Society for Crippled Children.

[1] Presented at the meeting of the American Society of Plastic and Reconstructive Surgery, Kansas City, Mo , November 15, 1946.

A TRIBUTE

FRED H. ALBEE, M.D.

1876–1945

For many years we have been concerned with a great social problem, the rehabilitation of the crippled and disabled. In the performance of our daily tasks, we bring mental and physical relief to thousands who would otherwise suffer the ignominy of social prejudice and the destruction of their fundamental hopes, dreams and desires. We would be remiss in our duties if in the discharge of our professional obligations we applied our skills only to the surgical needs of the victims of disabling accidents, diseases and malformations. The true reconstruction surgeon views his task as a three dimensional one, best epitomized by the philosopher Paulsen who said, "The object of all help is to make help superfluous."

It was Dr. Fred H. Albee, who gave surgical expression to this philosophy of rehabilitation. Both in the military service in World War I and as Chairman of the New Jersey Rehabilitation Commission for more than twenty-five years, he preached and practiced this modern concept of treatment which visualized not only the employment of advanced orthopedic methods and instruments but also the important social devices of education and vocational training, leading to the development of the patient's full physical and mental powers. Thus, fortified by the maximum development of his residual functions, the physically handicapped person can meet the competition of those who are free from physical defects. The beneficiaries of this broad concept of treatment were not only the large army of civilian disabled but the casualties of World War II as well. In the service hospitals were established the broad principles of rehabilitation, first promulgated by Dr. Albee more than twenty-five years before in General Hospital No. 3 at Colonia, New Jersey.

The world is well acquainted with the great contributions of Dr. Albee in the field of reconstruction surgery. The development of bone grafting was only one of many important basic technics, devices and ideas that he added to the armamentarium of the surgeon. But above all he brought to the countless legion of crippled and disabled hope and opportunity by the vision of a changed social status.

He was not one to be content with a parochial view of things. He gave his ideas and beliefs a wide canvas. He used the international platform not only to advance his progressive ideas in the field of orthopedic surgery but also to advance the cause of international and professional cooperation. In this regard he gave practical expression to his plans by helping to found the International College of Surgeons.

Many governments, nations and professional bodies have honored Dr. Albee in his lifetime. We have been honored by our association with him and the

Chapter on Diseases of the Mouth and Tongue, Jackson and Jaokson, 1915.
Numerous Journal Articles on diseases of the mouth, nose, throat and ears.

MILITARY SERVICE

First Lieutenant, Medical Reserve Corps, U. S. A., 1914–1918
Major, Medical Corps, U. S. A., 1918–1919

PERSONAL NOTES

On November 7, 1899, was married in Denver, Colorado, to Miss Mary Jane McBride, born in Corunna, Michigan. Their children are Mrs. Ruth Carmody Sumners, Denver, Colorado; Mrs. Mary Alice Carmody Cobb, Minneapolis, Minnesota; and David W. Carmody, District Attorney of Santa Fe, New Mexico.

His hobbies were golf and photography. Religious affiliations, Episcopalian. Member of University Club of Denver, the Denver Club, and the Denver Country Club.

His pleasing personality always made him popular with a large group of friends and with the members of the many medical and surgical organizations in which he held active membership. Always untiring in his wide range of activities, he derived his pleasures from contact with his fellow men and from his unfaltering efforts for their relief.

En route to Pueblo, Colorado, aboard a Braniff air liner, he fell asleep and on his arrival at the municipal airport was found dead of coronary occlusion.

We send our deep sympathy to his family in their bereavement.

WARREN B. DAVIS, M.D.

CICATRICIAL STENOSIS OF THE NASOPHARYNX: CORRECTION BY MEANS OF A SKIN GRAFT*

FREDERICK A. FIGI, M.D.

Section on Laryngology, Oral and Plastic Surgery, Mayo Clinic, Rochester, Minnesota

Numerous operative procedures for the correction of cicatricial stenosis of the nasopharynx are presented in the literature. Some of these are carried out in more than one stage and considerable time is required in order for the desired result to be accomplished. Others are useful only in selected cases. A few operations are excessively radical and deforming. The plan of treatment in the second case being presented herein would have been feasible in any of the cases of acquired stenosis of the nasopharynx seen at the Mayo Clinic. A highly satisfactory result was secured in the course of a few weeks.

Cicatricial stenosis of the nasopharynx occurs so infrequently that few surgeons have the opportunity of acquiring more than a limited experience in treating the condition. Most of the reports in the literature are based on the study and treatment of a single or, at most, a small number of cases. Accordingly, it seems desirable to present for consideration even minor technical changes in treatment in order that others may evaluate them. Thirty-seven cases of cicatricial stenosis of the nasopharynx have been encountered at the Mayo Clinic.

Cicatricial stenosis of the nasopharynx is not encountered appreciably more frequently in one sex than in the other. In a group of seventeen cases which I reported in 1929 (1), there were twelve male patients and five female patients. However, in twenty cases of nasopharyngeal stenosis encountered in the period of sixteen years from January 1, 1930 to January 1, 1946, nine of the patients were males and eleven were females.

The impression was gained from the original study that the condition occurred more commonly in children because seven of the seventeen patients were in the first decade of life and three in the second. However, in only half of the twenty more recent cases did the condition occur during the first two decades of the patient's life. Eight were in the first decade; two, in the second; five, in the third; and five, in the fourth.

Many authors have stated that syphilis is the most common cause of cicatricial stenosis of the nasopharynx. This is decidedly in contrast to the findings in the cases observed by us at the clinic. In fact a cause only infrequently mentioned by other writers has been chiefly responsible in our cases. Excessive trauma inflicted during tonsillectomy alone or combined with adenoidectomy induced the stenosis in twenty (54 per cent) of the thirty-seven cases. Syphilis was causative in eight (22 per cent) cases, an indeterminate inflammatory process in three, rhinoscleroma in two, a caustic burn with sulfuric acid in one, diph-

* Read before the Southern Section of the American Laryngological, Rhinological and Otological Society, Miami, Florida, January 6, 1947.

Fred H. Albee, M.D.

stimulation we obtained from his energetic and progressive spirit. In his passing, the society loses a great colleague and a man of action. We pause now to pay tribute to his memory, sensible of our debt to him and our abiding faith in his vision and inspiring leadership.

Henry H. Kessler, M.D.

characteristic concentric narrowing of the lumen which appears to be due as much to infiltration and thickening of the wall as to contracture of the scar. In these cases too the uvula is retracted posteriorly and upward onto the posterior aspect of the soft palate.

The symptoms of stenosis of the nasopharynx are essentially those of nasal obstruction and commonly are referred to the accessory sinuses and to the ears. They are dependent to a great extent on the degree of stenosis.

The fact that correction of cicatricial stenosis of the nasopharynx is difficult is manifested by the great variety of procedures advocated for its relief. Freeing the scarred attachment of the soft palate to the posterior wall of the pharynx with subsequent dilatation has been commonly employed but usually accomplishes little unless the opening is maintained by an obturator or an elastic dilator for an indefinite period. However, Goodyear (2) reported a case of almost complete stenosis which resulted from scarlet fever a number of years previously, in which a satisfactory result was secured simply by incising through the cicatricial diaphragm into the nasopharynx. No dilatation was carried out postoperatively. Diathermy has been used but has little to recommend it in this situation.

A number of plastic procedures have been devised for the relief of cicatricial stenosis of the nasopharynx. In most of these either pedicle flaps of mucous membrane secured from the cheeks, soft palate or pharyngeal wall or a skin flap from the neck inserted through a pharyngotomy opening is used.

The first operation described by Mackenty (3) can be used only in cases of partial stenosis in which the cicatrix is not too thick and not too dense. This procedure consists of turning up two flaps of mucous membrane from the posterior wall of the pharynx, one on either side of the stenosed nasopharyngeal opening. The base of each of these is situated at and is formed by the posterior border of the soft palate. After freeing the attachment of the soft palate to the pharyngeal wall, each of these flaps is doubled over onto the denuded posterior and superior surface of the soft palate and sutured in place. The disadvantage of this operation is that the posterolateral walls of the nasopharynx are left denuded. Both the second operation described by Mackenty (4) in which a cleft palate is produced and Axhausen's method (5) of turning in a skin flap through a pharyngotomy are too radical to warrant consideration.

In most of the cases presented in my previous report on this subject treatment consisted of the use of setons as advocated by Nichols (6) more than fifty years ago. This procedure is based on the antiquated method of dealing with syndactylia by placing a seton at the base of the web, allowing it to stay in place until cicatrization takes place and then incising to this point. It consists of inserting a heavy silk suture at each of the lateral borders of the stenosed lumen, allowing both to remain in position until a tract is established and then carefully dividing the intervening bridge of scar tissue. In our cases this was usually modified by clamping a split lead shot over the free ends of each seton so that it would cut through spontaneously in from ten days to two weeks. In most cases it was necessary to repeat this procedure at least several times. None of our patients

theria in one, lupus in one and an attempt at surgical correction of a congenital malformation of the throat in one.

The duration of the stenosis at the time these patients came for consideration varied greatly. One patient, a girl nine years of age, was brought to the clinic by her parents because of severe cicatricial stenosis of the nasopharynx which had developed after tonsillectomy which had been performed only two months previously (fig. 1). In contrast, a man, fifty-eight years of age, came because of marked stenosis of the nasopharynx that apparently had followed tonsillectomy and adenoidectomy forty-four years previously. He stated that nasal obstruction had been complete prior to a plastic procedure carried out thirty-five years before his examination at the clinic.

FIG. 1. Cicatricial stenosis of the nasopharynx resulting from secondary tonsillectomy and adenoidectomy performed two months previously.

Narrowing of the nasopharynx in these cases may range from slight asymptomatic contracture to complete closure. Atresia is encountered much less frequently than incomplete stenosis and it would seem well to restrict the use of this term to complete absence of the normal lumen. Atresia was observed in seven of the thirty-seven cases of stenosis. However, in several additional instances the lumen was so small that it was almost completely occluded. In three cases atresia was due to syphilis, two to inflammatory lesions of the throat, one to diphtheria and one to tonsillectomy and adenoidectomy. In the cases of incomplete stenosis the small lumen remaining usually was situated in the midline directly back of the uvula, providing this structure had not been destroyed. The uvula was missing entirely in the cases of complete atresia.

The thickness and density of the scarring varies greatly in these cases. It is likely to be more dense and extensive in the cases in which syphilis was the etiologic condition. Nasopharyngeal stenosis due to rhinoscleroma presents a

characteristic concentric narrowing of the lumen which appears to be due as much to infiltration and thickening of the wall as to contracture of the scar. In these cases too the uvula is retracted posteriorly and upward onto the posterior aspect of the soft palate.

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were unfortunate enough to aspirate the lead weights but this possibility was ever present. While the procedure was time consuming and it was necessary to repeat it, if used persistently it produced a satisfactory result in most cases.

Attempts have been made repeatedly to reline the nasopharyngeal lumen by means of a skin graft but usually these have failed because the graft was inadequately immobilized. In many cases the graft was held rigidly in position by means of a dental appliance. Since the pharyngeal wall moves with each act of swallowing there was necessarily constant play between the graft and the denuded area which it covered and on this account the possibility of a take was rather definitely precluded. O'Connor (7) overcame this difficulty with an ingenious procedure. He inserted a skin graft wrapped about a stent mold into a pocket created on the posterior pharyngeal wall at either side of the stenosed lumen. After the graft had taken, the fine web remaining at the border of this

FIG. 2*a*. Dense cicatricial stenosis of the nasopharynx with an opening approximately 2 by 3 mm. remaining posteriorly. *b*. Re-established nasopharyngeal lumen. An acrylic obturator was not used in this case and marked contracture recurred.

epithelized pocket was divided thus restoring the nasopharyngeal lumen.

In 1940 the method of relining the nasopharynx with a skin graft described subsequently was used in the following case at the clinic.

Case 1.—The patient was a woman, thirty-one years of age. Cicatricial stenosis had developed after she had undergone tonsillectomy and adenoidectomy at the age of three years. The patient had been subjected to numerous operations in which attempts were made to correct the condition and extensive dense scarring together with complete loss of the uvula were observed at the time she came to the clinic. An opening 2 by 3 mm. remained in the scarred palate (fig 2*a*).

Although the patient had purulent pansinusitis on admission it was thought that, because of her limited finances and her inability to remain under observation and treatment for a prolonged period, an attempt at skin grafting the scarred nasopharynx was advisable. The skin graft failed to take over a limited area on the posterior pharyngeal wall but took perfectly over the remainder of the denuded area. Postoperatively the patient wore a soft rubber dilator for a time but this produced a good deal of local inflammatory reaction and

marked deafness and she refused to continue using it. The diameter of the nasopharynx measured 2.5 cm. at the time the dilator was removed (fig. 2b) but shrank down to 1 cm. a week later. At this point it became necessary for the patient to return home and it has not been possible to secure a definite report on the condition of her throat since then.

Experience with the use of skin grafts for relining body cavities has demonstrated the necessity of maintaining dilatation for some weeks or months after operation because of the tendency for these grafts to shrink. This shrinkage is much more pronounced in regions where a rigid supporting wall is absent. For dilatation rubber tubes, airfoam rubber sponge or acrylic obturators have been employed. Each of these possesses certain features which render its use advantageous in given situations. In the light of experience with use of the acrylic obturator in similar conditions of other parts of the body, it seems best suited for use in the nasopharynx. It now seems probable that had an acrylic obturator been properly fitted in this case, a good result might have been assured.

In the following case an acrylic obturator was used and an excellent result was secured.

Case 2.—The patient, a housewife, aged fifty years, came to the clinic for treatment on September 16, 1946, because of nasal obstruction of eleven years' duration. She had undergone tonsillectomy in 1932 and the wound failed to heal. At that time results of serologic tests for syphilis were positive. Twenty-five intravenous injections of an antisyphilitic drug were given in the following three years. The wound in her throat healed promptly under this treatment but complete nasal obstruction developed.

Examination of the patient at the clinic revealed dense cicatricial atresia of the nasopharynx, complete destruction of the uvula and extensive scarring of the entire posterior and lateral walls of the pharynx (fig. 3). No other clinical signs of syphilis were observed. On serologic examination reaction to the Kline test was doubtful, results of the Kahn test were negative, and results of the Hinton and Kolmer tests were positive. Examination of the cerebrospinal fluid gave completely negative results.

Antisyphilitic treatment with penicillin was begun and five days later surgical correction of the atresia of the nasopharynx was undertaken. Local anesthesia was used. The patient was co-operative and topical application of 10 per cent solution of cocaine hydrochloride within the nose and to the nasopharynx and oropharynx, together with injection of a 0.5 per cent solution of procaine hydrochloride at the site of operation produced satisfactory anesthesia. The tip of a heavy curved probe inserted through either nostril into the nasopharynx was barely palpable through the densely scarred palate but it was possible, by use of the probe to determine the approximate level of the reflection of the mucous membrane on the posterior wall of the nasopharynx and the superior surface of the soft palate. A transverse incision, approximately 4 cm. in length, was made across the posterior wall of the pharynx below the lower border of the scarred attachment of the soft palate to the posterior wall of the oropharynx (fig. 3). This was carried entirely through the thickness of the scarring and was then extended upward in order to free the palate widely from its attachment to the posterior pharyngeal wall. The opening thus created was enlarged sufficiently to permit insertion of the index finger through it into both choanae. A sponge rubber mold through which two rubber tubes had been inserted for nasal breathing was then covered with a split-skin graft of medium thickness (fig. 3). The graft had previously been taken from the anterior abdominal wall. This graft was drawn up into the restored nasopharyngeal lumen by means of two heavy silk ligatures attached to its upper surface and brought out through the nostrils (fig. 3). Although the sponge rubber mold was of such size and shape as to be self-retaining, supplementary anchorage was deemed advisable and was secured by tying the traction ligatures mentioned previously together below the colu-

mella over a small rubber tube. In addition the edge of the palate and the pharyngeal incision were sutured directly to the skin graft and the mold supporting it.

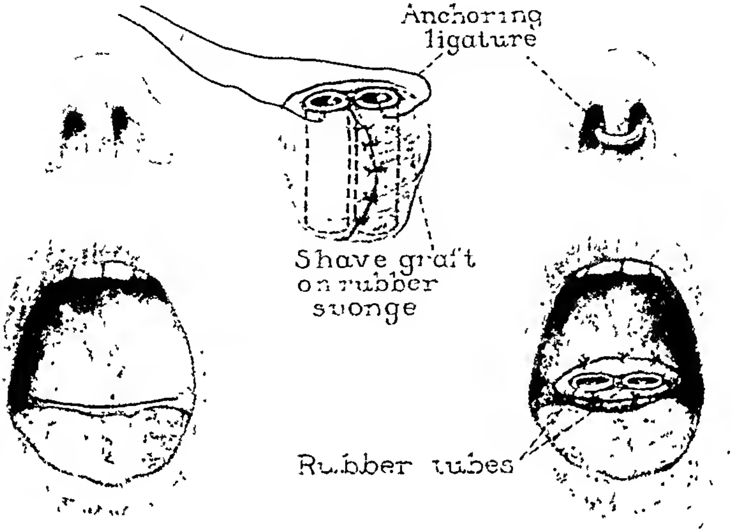

FIG. 3. Drawing on the left shows cicatricial atresia of the nasopharynx due to syphilis. Note transverse incision for re-opening the lumen. Center drawing shows the self-retaining sponge rubber mold with tubes for breathing and silk suture for supplementary anchorage below the columella. On the right the mold supporting the skin graft is in position in the nasopharynx.

FIG. 4. FRONT AND SIDE VIEWS OF SELF-RETAINING ACRYLIC (VERNONITE) OBTURATOR

Treatment with penicillin was continued postoperatively and the patient's convalescence was uneventful. The temperature at no time was elevated above normal. The thick mucous secretion that tended to accumulate in the nasal fossae, nasopharynx and in the rub-

FIG. 5. OBTURATOR IN POSITION IN THE NASOPHARYNX

FIG. 6 PHARYNX SHOWING RESTORED NASOPHARYNGEAL LUMEN

ber tubes within the mold supporting the graft was removed frequently by aspiration and and the patient was able to carry on nasal respiration during this period. The mold was removed for inspection of the graft on the tenth day. Complete take of the graft had been obtained. At the end of two weeks the sponge rubber mold was replaced with a self-retaining acrylic obturator (figs. 4 and 5) and the patient was dismissed from the hospital. The obturator was taken out for cleansing on alternate days and was worn for approximately two weeks. Following removal of the obturator the patient's voice had a decided nasal twang and fluids were regurgitated through the nose. A week later the voice retained only a slight twang and difficulty with regurgitation was minimal and was experienced only when she drank rapidly. It was anticipated that the speech impediment and the regurgitation of fluids probably would cease entirely as the induration and thickening of the palate and pharynx cleared.

The patient was dismissed from the clinic on the thirty-third postoperative day. At that time the nasopharyngeal lumen measured approximately 1.5 cm. and had shown no tendency to contract since removal of the obturator a week previously (fig. 6). The patient was advised to replace the obturator at intervals should shrinkage occur. Nasal breathing was free and the patient was highly pleased with the result.

SUMMARY

A brief review of the cases of cicatricial stenosis of the nasopharynx observed in the Mayo Clinic is presented. The various surgical procedures for correction of this condition are reviewed. A method of relining the stenosed nasopharyngeal lumen with a skin graft and a self-retaining obturator for maintaining the patency of the restored opening are described.

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THE USE OF NEIGHBORING TISSUES IN THE CORRECTION OF AN EXTENSIVE FACIAL DEFORMITY[1]

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The physiological function of the skin of the face is more variable and highly specialized than that of any other area of skin surface on the body. The skin varies in texture, elasticity, color, thickness, fixation to the skeletal frame and its hair-bearing qualities. The rate of transition from one type of skin to another is also variable. In most instances it is rather gradual but it may be abrupt. There is no skin of the body which will closely approximate these qualities of the skin of the face.

Ferris Smith, for several years, has strongly emphasized the importance and advantages of repairing soft tissue facial defects with the remaining skin of and about the face. This method should always be considered first despite the fact that it sometimes entails more effort and time.

If it is not feasible to use the skin adjoining the defect, skin from the corresponding area on the opposite side of the face may be used. This tissue will duplicate, in every respect, the skin which has been lost. The resulting disfigurement of the donor site should never be more than a fine, hairline, unnoticeable scar. The advantages of such a transplant over one taken from a distant part of the body more than compensates for a linear scar.

It is very important to plan the case as far into the future as possible before the first operative procedure, so that every square millimeter of available good skin will be used to the best advantage. Many times it is quite tempting to make a relaxing incision a little longer or make an extra incision to give more immediate shifting of the skin. This additional incision, though trivial in itself, when added to the otpimum may interfere seriously with future operative steps. Massive skin loss and injury to tissues adjacent to the defect may make it imperative that some distant area of the body be used as a source of skin. Instead of hastily resorting to this procedure, one should study the case thoroughly and make sure that it is not possible to utilize the local neighboring tissues. In the extensive wounds, in order to obtain immediate coverage, it is often best to use a temporary split graft from a distant area of the body. A temporary split graft may be necessary for some of the smaller wounds when the surrounding skin is bruised to the extent of preventing shifting or undermining. After the bruised skin has returned to normal the temporary graft is excised and the surrounding skin shifted to cover the original defect.

The larger wounds may require several operations to replace the temporary skin graft with the neighboring skin. The proper time interval between serial operations is quite variable in different individuals and between different opera-

[1] Read before the Annual Meeting of the American Society of Plastic and Reconstructive Surgery, Kansas City, Mo., November 16, 1946.

tions in the same patient. It may vary from a few weeks to several months One should always be careful not to let his or the patient's desire to complete the repair cause him to schedule the operations too close together. The number of operations may be reduced by allowing sufficient time between stages for the maximum skin relaxation to take place. The time interval is usually in proportion to the degree of stretching of the skin, how far it is shifted and how much skin is involved.

Massage of the skin should be started as soon as the incisions have healed well enough to tolerate manipulation. Much can be gained in the amount of stretching of the skin by carefully instructing the patient in the technique of massage. This will shorten the time interval between operations, and increase the distance the skin can be shifted at the next operation.

When multiple operations are to be performed on the same area of skin, every effort should be made to prevent stitch scars. The number of necessary skin sutures can be reduced by the use of very fine subcuticular sutures It is important to use sharp, fine, cutting needles and the smallest suture material Sutures should be removed as early as it is safe to do so After removal of the sutures the incision scar should be supported with some form of "straping" until the skin has relaxed sufficiently to prevent undue tension on the scar line.

One should try to obtain the maximum at each operation in order to keep the number of operative steps to a minimum, and not to prolong the time needed for the completion of the case. However, a better end result is much more important than the number of operations or the amount of time taken to complete the case.

CASE REPORT

Mrs. R L P was admitted to the hospital June 5, 1939 with a history of having been in an automobile accident one week previous Prophylactic Tetanus and gas bacillus vaccine was given the day of the injury Examination revealed a very sick patient in excruciating pain There was a marked amount of tissue necrosis and infection of all the facial wounds All of the skin and underlying soft tissues of the middle one-half of the forehead were missing, exposing the frontal bone The wound extended from the hair-line of the forehead to the upper third of the nose and included the inner one-third of the right eyebrow The skin surrounding the open wound was inflammed and swollen to about four times its normal thickness There was a comminuted, depressed fracture of the nasal bones with gross displacement to the left There was a large section of the nasal process of the frontal bone missing The bony and cartilagenous nasal septum was also badly comminuted There was a through-and through laceration of the upper lip There were extensive, multiple lacerations about the nose, upper lip, right eyelids and right cheek On the trunk and extremities there were numerous scratches and brush burns (fig 1)

Due to the patient's critical condition and the acute infection of the wounds surgical repair was not undertaken The wounds of the face were treated with continuous, wet boric-acid dressings and changed hourly The necrotic tissue was removed daily for about a week as definite lines of demarkation were formed between the dead and healthy tissues Sixteen days after injury patient developed Tetanus She was treated with Tetanus antitoxin and barbiturates All closed wounds were opened and debrided in an effort to eliminate all possible foci of the Tetanus infection Patient was free of all signs and symptoms of Tetanus after two weeks

On July 7, five weeks after injury, the exposed portion of the outer table of the frontal

Fig. 1

Fig. 2

Fig. 1. Patient one week following treatment with wet dressings. Large area of the outer table of the frontal bone exposed.

Fig. 2. Granulating wound three weeks after removal of the outer table of the frontal bone.

Fig. 3

Fig. 4

Fig. 3. Six weeks following split graft to the forehead

Fig. 4. One year and a half following split graft to the forehead

bone was removed with chisel and electric burr, for the purpose of obtaining a granulating base for a skin graft (fig. 2). Three weeks later this wound was completely covered with a medium-thick, split graft taken from the medial aspect of the thigh (fig 3).

Fig. 5

Fig. 6

Fig. 5. Showing the depression of the forehead, supraorbital ridge and noses.
Fig. 6. Three years after injury showing complete correction of the facial defect except for slight elevation of the medial one-half of the right eyebrow.

Fig. 7

Fig. 8

Fig. 7 and 8. End results. One and one-half years following last operation. Sharp-focus photograph of patient without cosmetics.

When all the wounds of the forehead and face were completely healed the patient was discharged. She was instructed to massage the skin to facilitate shifting of the forehead skin and to return after three months for the next operation.

One year and a half later, Jan. 20, 1941, the patient returned for correction of the facial defect. There was a marked depression of the forehead over the area where the outer table of the frontal bone had been removed and skin grafted. The upper third of the bridge of the nose was markedly depressed and covered by a very thin scar. There was a marked depression of the middle half of the right supraorbital ridge and an absence of the inner third of the right eyebrow (figs. 4 & 5). It was decided to completely remove the previously applied skin graft by multiple excisions and to cover this defect with the remaining normal forehead skin. The unstable scar of the upper part of the nose was also to be removed by fractional excisions.

At the first operation, an incision was made around the periphery of the skin graft of the forehead. The surrounding skin and underlying soft structures, down to and including the periosteum, were undermined laterally to the region of the parietal suture lines. The skin on either side of the wound was stretched over the skin graft, as far as possible, to ascertain how much of the skin graft could be removed. Lateral relaxing incisions were made along the hairline of the upper part of the forehead and along the upper border of the left eyebrow. On the right side the relaxing incision was made below the remaining portion of the eyebrow, so that it might be shifted medially with the right forehead flap. To aid in correcting the depressed area of the forehead, the portion of the skin graft to be excised was dissected as thinly as possible. Skin margins were shifted medially to approximate the edges of the remaining skin graft and sutured in place. Approximately ⅔ of the temporary skin graft was removed at this time. About 1½ cm. of the central portion of the scar of the upper part of the nose was excised. The remaining scar and surrounding skin on either side of the nose was undermined sufficiently to allow the edges of the wound to be brought together in the midline. Two weeks following the operation the patient was instructed to begin massage on the forehead skin.

Three months following the first excision, approximately ½ of the remaining skin graft was removed and replaced by further shifting of the normal forehead skin. At the same time, the inner half of the right eyebrow was dissected free, with incisions above and below, allowing the eyebrow to be elongated and sutured in near normal position. The remaining portion of the scar of the upper part of the nose was completely excised and replaced with normal skin from the sides of the nose.

Six months following the second excision of the graft, the remaining portion of the temporary skin graft of the forehead was removed. The skin on either side of the wound was extensively undermined beneath the periosteum. To permit adequate shift of the periosteum to cover the depressed area, it was necessary to make a vertical relaxing incision through the periosteum on the underside of the forehead skin flaps. The edges of the periosteum of the forehead flaps were sutured together with interrupted 4-0 chromic catgut. The skin edges were sutured with interrupted 4-0 and 5-0 black dermal silk.

On February 17, 1941, between the first and second excision of the forehead graft, a nasal reconstruction, including a replacement type of submucous resection, was performed. All the bony framework of the nose was completely mobilized to permit reshaping of the nose in its normal position.

Six weeks following the nasal plasty, the depression of the glabella region of the nose and supraorbital ridge was corrected with a pickled cartilage graft. The implant for the nose was inserted through an intra-nasal incision at the bony cartilaginous junction. An incision was made along the lower border of the right eyebrow for insertion of the cartilage to correct the depression of the supraorbital ridge.

Three years after injury the patient returned for observation. The only remaining defect was a ½ cm. upward displacement of the medial one-half of the right eyebrow (fig. 6). This was corrected with a simple "Z" incision and transposition of the angular flaps (fig. 7 & 8).


FIG. 5 FIG. 6

FIG. 5 Showing the depression of the forehead, supraorbital ridge and noses.
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Three months following the first excision, approximately $\frac{1}{2}$ of the remaining skin graft was removed and replaced by further shifting of the normal forehead skin. At the same time, the inner half of the right eyebrow was dissected free, with incisions above and below, allowing the eyebrow to be elongated and sutured in near normal position. The remaining portion of the scar of the upper part of the nose was completely excised and replaced with normal skin from the sides of the nose.

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THE IMMEDIATE REPAIR OF WAR WOUNDS OF THE FACE[1]

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The immediate or delayed treatment of war wounds involving the soft tissues has been under prolonged discussion. The past war proved no exception and a generous discussion accumulated regarding the effectiveness of various methods of therapy. In this report we are particularly concerned with the immediate treatment of war wounds of the facial structures.

There is no clear line of differentiation in the time limits dividing immediate and delayed treatment. It is evident that all definitive treatment must of necessity be somewhat delayed. However, we consider treatment given with the first 24 to 48 hours after injury as immediate and treatment given after 48 hours, as delayed treatment. Wounds communicating with the oral or respiratory cavities exhibited moderate surface exudate within 18 to 24 hours after injury. In our experience, this is not to be construed as infection of the wound, limiting definitive treatment. After 48 hours these wounds frequently assume a most unclean aspect and after this period those wounds to be closed primarily should be selected with care. We have closed wounds (with drainage) 96 hours old, and have achieved primary healing, but we do not feel that this procedure should be applied to all wounds so old.

Since gas gangrene and tetanus arising from injuries of the facial structures is virtually unknown, a potent reason for not primarily treating soft tissue wounds of the face is removed. By virtue of their excellent blood supply and rapid healing properties, facial tissues fall in a separate category from more peripheral portions of the body. However, authorities differ in their opinion as to the best time to repair facial injuries. As as example of these differences, passages may be quoted from the two Military Manuals discussing facial wounds. In the Plastic and Maxillofacial Surgery Manual (1) the following recommendations are given: "Shreds of obviously devitalized tissue are cut away, but displaced flaps of tissue may be sutured back in approximate position. Edges of skin and mucous membrane in large wounds communicating with the mouth should be sutured together so as not to leave raw surfaces and bone exposed. Wounds of the soft tissue communicating with the mouth or involving the mandible, that become infected should have dependent drainage provided. Wounds associated with the superior maxilla with adequate soft tissues remaining, may be completely closed, and if drainage is indicated, an intra-oral point may be established." The Manual of Ophthalmology and Otolaryngology (2) states, however: "There is a great temptation on the part of surgeons to try to operate as soon as they see a patient admitted to the hospital with a large gaping wound of the face. One must remember that with the exception of wounds simulating

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civilian injuries, war wounds are most markedly lacerated, become quickly infected and are associated with fractures of the facial bones. Finally, in a certain number of them there has been actual loss of tissue. Primary suturing of gunshot wounds of the face has been practiced frequently in the past, but the results have been totally unsatisfactory. Only in cases of mild and superficial wounds has healing taken place, and when damage to the soft tissues has been accompanied with bony injury, the attempted closure has ultimately given away and brought on added inflammation and sloughing with discomfort to the patient. While there is but a limited field for primary suturing, there is a broad scope for late primary suturing of soft tissue of the face. In this respect, the proper procedure is first to apply frequent warm fomentations until the local inflammation disappears, to immobilize fractures and to resort to repairing soft tissues. In many cases, it is possible to operate even on very extensive wounds within the first two weeks. Wounds in which there is definite loss of tissue cannot be repaired adequately at an early period."

Rauer (3), in summarizing his experiences in treating maxillofacial injuries with the Russian armiés states that he has used the delayed method of suture with great success in a series of 150 cases, obtaining smooth healing in 87 per cent of the cases. In 10 per cent of the cases, partial separation of the wound occurred and in the remaining 3 per cent more or less complete separation of the wound occurred. The wound is closed without interfering with the granulation layer and without undercutting the skin edges, usually between the eighth and twelfth days when most of the necrotic tissue has separated. Older wounds are treated by complete excision of the granulating bed, followed by undercutting of the skin margins. Ordinarily, Rauer states, the early closure heals more smoothly with a superior cosmetic result. Virenque (4) of the French Army, is also in favor of delayed closure, for, he says, these wounds are characterized by early infection and it is desirable to eliminate this before attempting any surgical treatment. Clarkson and his associates (5) have recently published an account of early treatment of maxillofacial injuries in the British Army. Their findings indicate that early treatment is preferable to delayed treatment and we agree with most of their conclusions.

Our objections to the delayed suture of facial wounds are: 1. A long lapse of time after injury to allow dead tissue to separate appears to be unnecessary and undesirable, since similiar effects are gained by primary debridement of the wound. 2. Such a delay is uncomfortable to the patient, particularly those with cheek and mouth wounds. 3. The incidence of serious secondary hemorrhage is likely to be increased by delayed treatment, with its attendant suppuration and autolysis of dead tissue and the inflammatory reaction about the multiple foreign bodies composed of bits of teeth and bone driven deeply into the tissues. 4. The functional and cosmetic results of delayed treatment are not superior to those produced by early treatment. 5. Convalescence of the patient is lengthened and he is not fit for transfer to a maxillofacial center for final repair so soon as would otherwise be possible.

From the cosmetic view point alone, there is a real objection to delayed suture

since the wounds may not be closed in layers, thereby allowing contraction of the healing wound to proceed en mass. Ordinarily, in the technic of delayed closure, through and through stitches are applied for coaptation of the wound margins. In this manner, the granulations of the wound margins need not be disturbed, as Rauer points out. Figs. 1–4 illustrate such a case treated by Dr. Clovis Blanc of the French Army during World War I by this technic. The extreme contracture resulting is presumably associated with the contraction

FIG. 1. World War I wound of face, approximately 1 week after injury. Patient of Dr. Claude Blane. We would treat a wound of this extent by primary suture.

between the opposing surfaees and the laek of close adaptation of the two edges. In the final repair of this contracted wound, a defeet will be produced by the excision of the scarred tissue, which will be very similiar in size and shape to that produced by debridement of the original wound, in preparation for primary suture. Therefore, we feel that superior eosmetie results are likely to be achieved in selected cases by immediate repair in layers after judieious debridement.

The role of administered sulfonamides and penicillin in the immediate repair of these wounds is probably important. The wounded soldier has been taught to dust his wounds with sulfanilamide prior to applying a dressing, and this practice was followed by battalion aid men also. Whether or not this proeedure

actually acts to promote bacteriostasis is subject to some dispute. All the patients treated in our series received penicillin intramuscularly from the time of entry into the evacuation hospital where they were operated. No sulfonamide was used in the wounds at operation, but many of the patients received sulfadiazine orally in addition to the penicillin. Florey and Cairns (6) studied the effect of penicillin in the treatment of wounds incurred during the North African campaign and stated on the basis of their observations that open flesh wounds and head wounds can be safely and tightly closed if dealt with early,

FIG. 2. FIVE DAYS AFTER DELAYED CLOSURE

providing penicillin solution is administered locally in the wound after debridement. Their results in the number of successful closures are not better however, than those of Le Maitre (7) who practiced primary closure in World War I with notable success Mowlem (8) has recently studied the effects of penicillin in the treatment of mandibular infections and support is given to the feeling that penicillin may sufficiently control infection to allow healing to proceed normally. However, as Meleney (9) points out, it is difficult to evaluate the effects of drug therapy in surgical cases because of the great variations in individual cases, as well as the lack of carefully controlled studies

Patients with wounds similar to many of the cases illustrated in the military

manuals as well as those pictured in other articles written after World War I are now considered by us as candidates for immediate closure. It seems that several things militated for successful early facial surgery in the past war. They were, the early evacuation of a wounded soldier to a surgical team often within twelve hours; possibly the early use of sulfonamides and penicillin to limit bacterial activity in these wounds; and finally, a better understanding of plastic technic and the usefulness of pressure dressings.

FIG. 3. APPROXIMATELY ONE MONTH AFTER SUTURE. NOTE BEGINNING CONTRACTURE

Although we had no previous experience with extensive wounds of the type seen, it is evident that many of them were analagous to the more severe facial injuries occasionally encountered in civilian life. The wounds fell into two categories: 1. Those with moderate or no soft tissue loss and 2., those with extensive soft tissue loss. Either of these groups may be found with or without underlying bony damage.

These patients were operated on with novocaine infiltration or blocks, pentothal, or intratracheal gas-oxygen-ether anesthesia. For those severe facial-wounds with damage into the mouth and destruction of facial bones adjoining

the oral and respiratory passages we used intratracheal anesthesia almost exclusively.

The treatment of the bony injuries which we employed is fairly routine and has been described often. It consists briefly, in the repositioning of such fragments as have sufficient attachment for viability, the debridement of all loose particles of bone and teeth, the extraction of fractured teeth and tooth roots and finally, the fixation of the bony fragments by means of arch bars, wires and elastics, and occasionally, gauze packing for the thin bones of the middle third of the face.

FIG. 4. Approximately three months after suture. Extreme contracture necessitating reexcision and resuture.

An attempt was made to remove bullet and shrapnel fragments at this time, usually through the wound of entrance. Occasionally, counter-incisions were necessary for reaching a deeply embedded missile. It was useful to plan this incision so that the distal end of the tract could be located through it, otherwise considerable difficulty may be experienced in finding the foreign body. The counter-incision is also planned to avoid any important anatomical structures which might be severed in a search for the destructive agent. This occasionally necessitates the placing of the incision in a remote area dissecting up to the missile through the deeper structures instead of the reverse simpler method.

In one such case, that of a shrapnel wound of the substance of the cheek anterior-posteriorly with lodgement of the fragment in the lateral surface of the ramus of the mandible below the sigmoid notch, the shrapnel was removed by making an incision beneath the angle of the jaw and stripping up the masseter muscle until the foreign body was reached. This, then, is a military application of the well-known Risdon approach to the temporomandibular joint. Rather frequently it was impossible to remove all metallic fragments because of their wide and deep distribution throughout the facial structures. These procedures were ordinarily performed before the soft tissues were treated because of ease of access prior to suture of the facial structures.

Fig. 5. Patient A. J.—Shrapnel wound of cheek, maxilla and zygomatic bone with moderate loss of tissue. Note the lacerated character of the soft tissue.

In the treatment of the soft tissue injuries, it is evident that only those injuries with a slight to a moderate amount of soft tissue loss can be immediately closed. Considerable laxity exists in the cheek, particularly in the anterior-posterior direction as can be demonstrated by pinching the cheek roughly indicating the amount of soft tissue immediately available for closure. Frequently in a very extensive wound, actual tissue loss is small but displacement of tissue may be marked. Sufficiently large loss of a cheek to require lined flap replacement is obviously beyond the scope of early repair, but moderate cheek losses can be effectively and successfully repaired with a high incidence of healing and a shortening of the convalescent period.

These wounds exhibit extreme degrees of laceration with many multiple radiating tears running from a central defect, figs. 5–7. In certain areas the entire epidermal layer of the skin has been removed leaving the corium behind. Ordinarily, these areas are sufficiently large to preclude complete excision. Therefore, their margins are trimmed in a manner similar to adjoining regions and this

FIG. 6. PATIENT A. J.—BONY DEFECT ASSOCIATED WITH SOFT TISSUE LOSS

FIG. 7. PATIENT A. J.—Repair of soft tissue in layers. The bony injury has been debrided; the cavity resulting from loss of bone structure has been packed through the mouth with fine mesh gauze moistened with compound tincture of benzoin. Such a dressing will not become foul within a week.

superficially damaged patch of skin is utilized in the repair. These areas do not present a contraindication to early treatment, in our experience. Many of these patients exhibit paralysis due to peripheral section of the branches

Fig. 8. Patient J. M.—Bullet Gutter Wound of the Cheek and Nose

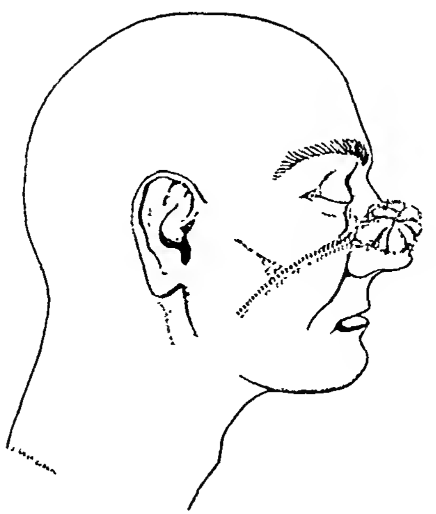

Fig. 9. Patient J. M.—Closure of cheek wound by undercutting margins. Perichondreal edges sutured on nasal defect and split-skin graft tied in position. Nares dressed lightly with vaseline gauze to assist in molding the mucosal surface.

of the facial nerve. We have seen no instance in which repair of the nerve was possible. Separation of the parotid duct has undoubtedly occurred in conjunction with some of these injuries, but in the marginal destruction of tissue present, the proximal end has never been noted. Evidence has been presented by Morestin (10), and others that simple ligation of the proximal end of the parotid duct has resulted in cure of salivary fistulas without any untoward effects being noted in the gland itself. In general, however, the results of injuries to these structures remained as additional problems for later treatments.

The first step in the closure of the soft tissue is to debride the margins. This is done by trimming the devitalized tissue and a narrow portion of viable tissue from the other structures using a very sharp knife along the margin to be removed. No attention is paid to the pattern of the defect nor are the small radiating lacerations debrided at this time. The mucosal and muscular layers are first closed separately. The mucosa is ordinarily sutured with fine black silk, typing the knots on the oral surface to expedite suture removal. The muscular layer is next joined by interrupted sutures of fine silk or 4–0 chromic catgut. We feel that closures of these wounds in layers is important to produce dispersion of the scar and therefore the least subsequent contraction of the sutured area. The skin defect is closed by means of sliding flaps, rotation flaps, or interpolated flaps of skin and subcutaneous tissue, or more rarely, by the use of the free skin graft which serves primarily as a physiologic dressing restricting the full development of contractions. It is placed with the intention that it will be removed at a subsequent time to provide for a more suitable cosmetic restoration. We have used all these methods with satisfactory results. The free skin graft has been used almost entirely on wounds of the nose where sufficient adjoining skin cannot be mobilized. Figs. 8–9. Ordinarily, elsewhere on the face, by the use of judicious incisions and planned rotations moderately functional and cosmetic results. The tension is relieved from the cutaneous margins by generous undercutting and by the use of fine white silk or 4–0 plain catgut stitches passed through the deep layers of skin. The skin itself is sutured either with fine black silk or fine nylon. Closure of the skin defect by these methods usually places the skin suture line in a different plane than that of the deeper layers, an important protection against contraction of the healing wound in a deforming manner. Whenever possible, small interpolated flaps of skin and subcutaneous tissue are utilized in closure to avoid contracting pulls in straight lines. Figs. 10–14.

An important feature in the treatment of all wounds communicating with the oral or nasal cavities, is the establishment of drainage at one or more points extending from the cavity to a dependent area. Figs. 15–16. This is particularly true in those cases associated with fractures of the mandible. Here we always establish through and through drainage from the fracture site. Small penrose rubber tubing has been found satisfactory for this purpose. Those wounds not communicating with the oral cavity may be closed without drainage if the debridement is considered adequate. However, even here, it is felt that a

narrow piece of rubber tissue extending into the wound depths and emerging from one angle of the skin incision is good insurance against later suppurative reactions. This drain may be removed after 24–48 hours and leaves little additional scarring. Finally, the wound is dressed with a single layer of vaseline gauze, and several moist dressings to absorb any immediate bloody ooze from the wound. Over these are laid a number of gauze dressings, and finally an elastic cotton bandage, as the Ace bandage, is applied over all. This furnishes

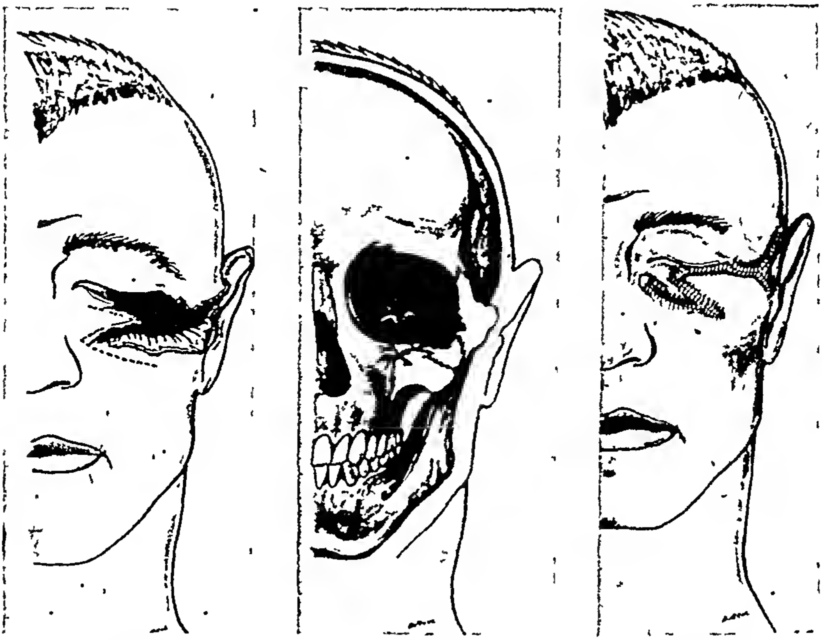

Fig. 10 Fig. 11 Fig. 12

Fig. 10. Patient L C.—Shrapnel wound of left eye with loss of the lateral 2/3 of the lower eyelid.

Fig. 11. Patient L. G.—Fracture of the floor and lateral orbital border. Direct wiring of the fragments with a single fine stainless steel wire.

Fig. 12. Patient L. C.—The eyeball has been enucleated, the soft tissue wound debrided and two flaps interpolated for reconstruction of the lower eyelid. The conjunctiva has been sutured to the margin of the superior flap providing a lining

good constant pressure against all the wound layers and is easily regulated. We feel that a proper pressure dressing is one of the most important factors in the successful results achieved in early treatment.

We have not hesitated to do a tracheotomy if there was any question about the adequacy of the air-way. However, not over 2% of the facial injuries required tracheotomy. Repositioning of the fractured mandible with adequate fixation and the use of adequate pressure dressings to minimize post-operative swelling kept the incidence of respiratory difficulties at a low level.

FIG 13 Patient H S—Shrapnel wound of cheek and neck Fracture of lower border of zygomatic arch with attachment of bone to the masseter muscle This has been reunited to the arch with several fine stainless steel wire sutures There is a complete facial paralysis

FIG 14 Patient H S—Closure of soft tissue wound A small flap of skin has been interpolated behind the ear giving additional length to the posterior neck flap and breaking the line of pull of subsequent contraction

FIG. 15. a. and b. Patient A. L.—Shrapnel wound of cheek with destruction of the hard palate and fracture of the maxilla resulting in forward displacement of the upper jaw—an unusual injury. There is a separate superficial wound of the forehead.

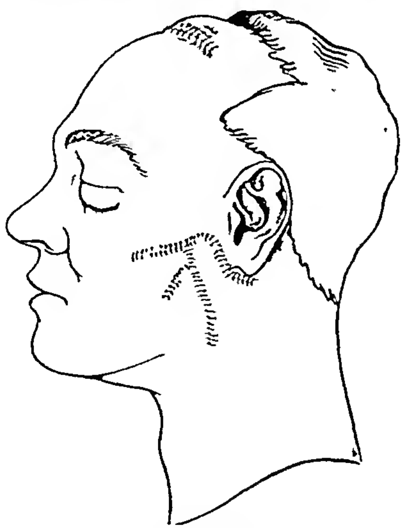

FIG. 16. Patient A. L.—Closure of a square wound of the cheek by advancement of a flap from the cheek and neck. Drainage is applied intraorally here as in Patient A. J. Fig. 6–7.

FIG. 17. Patient G. V.—Shrapnel wound of cheek, passing through mandible, hyoid bone and larynx. Shrapnel lodged in wall of larynx.

FIG. 18. PATIENT G. V.

Although the repair of large wounds required 3 to 4 hours of intensive work, we did not see any undue effects from keeping these patients anesthetized for this period of time. We have no reason to believe that these procedures are too

extensive for the wounded of the age group treated. Of course, if multiple wounds were present, it often was not possible to carry through such a complete program of reconstruction. The most vital parts were repaired first and the remainder of the wounds treated in such a way that their later care could be expedited.

An attempt was made to keep the patient in the evacuation hospital until after the sutures were removed and respiration and swallowing were adequate. Skin sutures were removed on the 4th day at which time satisfactory healing had usually taken place.

Fig. 19. Patient G. V.—X-ray of mandible. Note typical comminution of mandible and collapse of lower jaw.

SUMMARY AND CONCLUSIONS

The problem of immediate or delayed repair of war wounds of the facial structures is discussed. In our experience, immediate repair is preferable of those wounds in which tissue loss has not been too great in that it produces good immediate functional and cosmetic results and lessens the convalescent time of the patient. The bony structures are debrided and apparatus for immobilizing the jaws is installed first. The soft tissue wounds are debrided and sutured in layers. Defects of the cutaneous covering are closed usually by sliding, rotated, or interpolated flaps of skin and subcutaneous tissues, or more rarely, by free skin grafts. All wounds communicating with the oral, or nasal passages are drained. The importance of a pressure dressing to the wounded area is mentioned. It is recognized that not all facial wounds can be closed immediately.

By these procedures, the patient is made more comfortable, requires less nursing care and can be transported earlier than we believe would be possible by

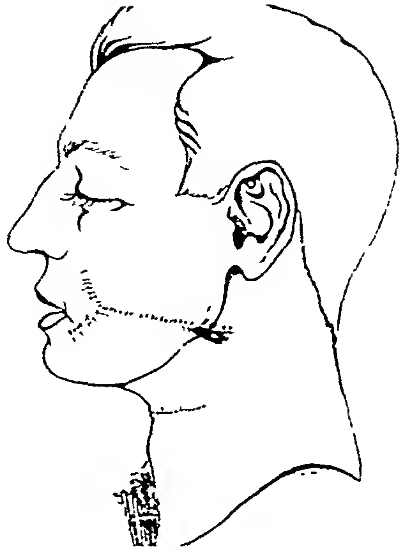

FIG. 20. Patient G. V.—Repair of wound. A counter-incision has been made over the hyoid bone, for debridement of the lower portion of the tract and removal of the shrapnel. The mandible has been repositioned. The soft tissue is closed in layers. The drain extends into the mouth at the fracture site. A tracheotomy has been done. Intratracheal anesthesia. The tube was permanently removed 9 days after operation.

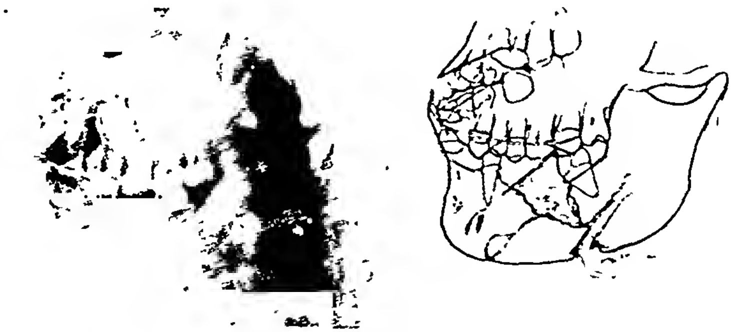

FIG. 21. Patient G. V.—X-ray of mandible after repair. Compare with Fig. 19. The mandibular arch has been repositioned; the posterior fragment with its one remaining tooth has been wired in occlusion The remainder of the mandible has been positioned in occlusion by means of Risdon wire arches and elastics. Note the positioning of the large detached fragment at the lower border of the mandible. There is a good chance that this mandible will reunite without bone grafting.

delayed treatment. These conclusions represent the opinions reached after treating over 450 war wounds of the face.

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RESTORATION OF THE CHEEK BY USING THE SKIN OF THE JAW-NECK REGION

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Restoration of a through and through defect of the cheek, that is, outer skin and the mouth cavity mucous lining, becomes necessary most frequently after radical removal of malignant tumors in this region. In such cases we cut far into the sound tissue for at least $1\frac{1}{2}$ to 2 centimeters away from the malignant growth, resigning to a much greater insufficiency as a result of this way of operating. It is best, of course, to remove the whole of the malignant growth as a complete piece surrounded by a margin of healthy tissue. Accidental cuts into the malignant tissue during the operation create a possibility for concealed spreading of tumor cells. Undoubtedly, it is equally important to find and remove all unhealthy and doubtful lymph nodes in that region. The restorative intervention undertaken for the covering of the operative defect should be adjusted to those peculiarities of the prime operation.

The prime operation is the fateful operative action which will decide both the fate of the patient and that of the grafting, and its entire accomplishment should not be injured through the desire, so often occurring to the operator, to save tissue, in order to lessen the problem of the subsequent restorative operation. We could say that those who remove the malignant tumor very economically, trying to aid the repair, in reality lose much more healthy tissue as they involuntarily prepare the ground for a speedy recurrence.

Restoration of a whole cheek becomes necessary also after extensive soft tissue losses due to wounds, burns, inflammatory necrosis, et cetera.

Where can we get such an extensive piece of covering tissue as is necessary for recreating the cheek? Here is the difficult problem, which has stimulated the working out of a great variety of operative procedures. Naturally, in restoration of a whole cheek, twice as large a skin cutting is necessary, as it is folded on itself in order to form the outer covering of the cheek, as well as oral cavity lining. Besides that, the skin graft should be sufficiently wide so as not to hinder the movements of the lower jaw. Owing to the necessity of extensive covering tissue, many surgeons attempt complicated distant grafts, which require several consecutive restorative operations, uncomfortable immovable casts, and long postoperative treatment. The cases are not rare where before the restorative intervention, lasting several months, is completed, a fresh malignant secondary tumor appears, thus ruining the work of the surgeon and causing despair to the patient, already distressed by the long treatment. In old people the casts, for example, of an upper limb with the head, created favorable conditions for joint contractions, ankylosis, et cetera. On the other hand, lying a long time in large casts conceals

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in itself the danger of giving rise to hypostatic pneumonia. Undoubtedly, that operative procedure which could make possible the restoration of the cheek by using neighboring skin would be far simpler, safer, and more easily endured by the patient. The idea for using the neighboring skin in restoring the cheek made the foundation in the working out of a method, the description of which follows.

In the side region of the neck, in and under the fossa carotica, a trapezium-shaped skin incision is made (figure 1) which really represents a prolongation of skin lying immediately under the cheek defect (the skin of the jaw and that of the region under the jaw). The trapezium-shaped incised flap is elevated together with the underlying fatty tissue. In the same way, the skin lying over

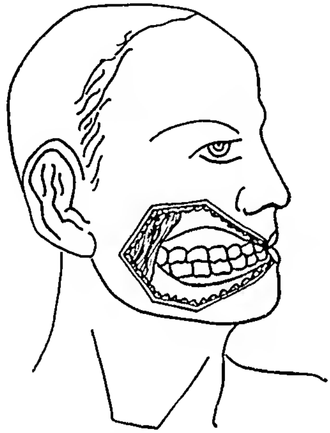

FIG. 1

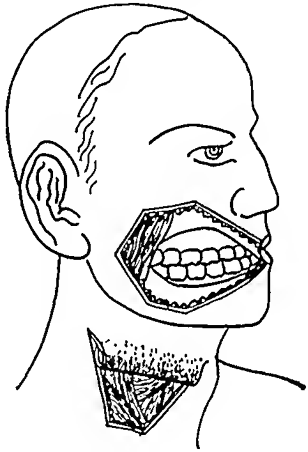

FIG. 2

FIG. 1. In the side region of the neck (in and under fossa carotica) a trapezium-shaped flap is made, which will be used as the inner wall of the skin transplant.

FIG. 2. The whole skin covering between the cheek defect and the trapezium-shaped cutting is undermined far into the sides, toward the chin and toward the ear. Thus a broad skin band with two nourishing bases (one at the chin and the other at the ear side) is formed. The trapezium-shaped cutting is folded upward, and in this way the inner side of the flap is lined with normal skin.

and under the jaw region is elevated not only upward toward the cheek defect, but also sideways toward the angulus mandibulae and toward the chin. Thus a broad skin flap is made with two nourishing bases (toward the chin and toward angulus mandibulae) and with an extensive trapezium-shaped prolongation downward. By folding the trapezium-shaped flap upward, the back of it is lined with normal skin (figure 2). Now the flap is equipped on both sides with epidermal covering and can be moved upward in order to fill up the defect of the cheek. It is then stitched to the upper edge of the cheek opening by a double seam, that is, to the mucous membrane of the mouth cavity, as well as to the skin of the cheek (figure 3). With this procedure the main operation is completed. The next step is the closing of the operative wound in the region of the neck. This is easily done, as the skin of the neck is very mobile and elastic. In the sub-

maxillary region only a small strip is left uncovered which, later on, about fifteen to twenty days after the operation, is covered by letting down the superfluous part of the folded upward trapezium-shaped cutting (figure 4). That is, for lining the cheek only the upperfolded part of the trapezium-shaped cutting is used (figure 4, the margin marked by the dotted line) and the rest is pulled downward.

The described operation is technically easily accomplished; it is done at one sitting. For the small correction of the lower edge of the upturned trapezium-shaped cutting, the patient can come as an ambulatory case. When restoration

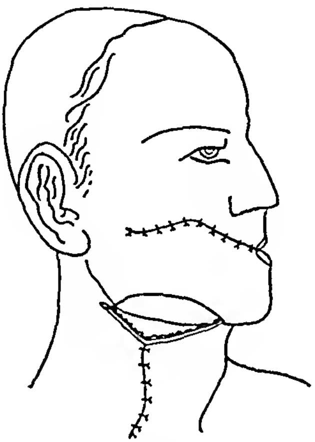

FIG. 3

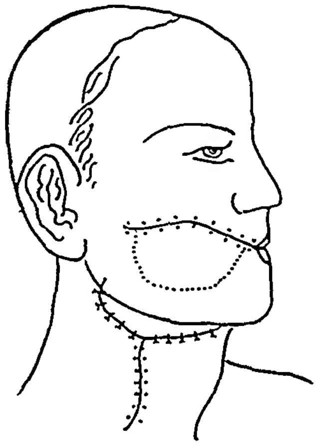

FIG. 4

FIG. 3. The prepared skin flap, which has two nourishing bases and is covered on both sides with skin, is moved upward over the cheek defect. The operative wound in the side region of the neck is closed by mobilizing the skin edges. This is easily accomplished, as the skin of the neck is extremely elastic horizontally. Only in the region under the jaw a small area is left uncovered.

FIG. 4. In ten to fourteen days after the operation, the unused portion of the folded upward, trapezium-shaped cutting is pulled downward in order to cover the remaining operative wound in the region under the jaw. Thus, for the inner side of the cheek, only the upper part of the trapezium-shaped cutting is used—that is, as much skin as is necessary to substitute for the missing mucous membrane (the margin marked by the dotted line).

of the cheek is undertaken after removing a malignant tumor, the regional lymph nodes can conveniently be removed; in the above described plastic operation the whole region of the side of the neck, the underchin included, is widely exposed for the observation of the operator. On the other hand, because only neighboring skin is used, all immobile casts and splints are unnecessary. The grafted skin band heals up quickly and securely, as it has a double pedicle—that is, two nourishing bases. The good blood supply of the graft assures the success of the restorative intervention even in old people, in whom the reconstructive operations commonly undertaken are rarely successful. The great elasticity of the skin of the neck provides abundant material for covering purposes. It is evident

Fig 5

Fig 6

Figs 5 and 6 The secondary spinocellular cancer has extended over a large part of the right side of the face, including the whole cheek and parts of the upper and lower lip The tumor masses have penetrated the skin as well as the mucous membrane of the mouth cavity

Fig 7 The trapezium-shaped cutting in the side region of the neck is elevated The skin lying above it as far as the defect and far into the sides, toward the chin and the angulus mandibulae, is also elevated Now the trapezium shaped cutting will be folded inward and upward, and in this way a large skin band wil
normal skin and possessing two nourishing bases—
The skin band will be moved upward in order to fill the cheek defect

from the figures that there exists a very large cheek insufficiency, which extended not only over the whole cheek, but also over adjacent parts of the right side of the face. At the end, let us mention the fact that during the treatment the patient is not confined to bed. He may move freely. Six days after the operation he may start feeding by mouth. Under these circumstances the whole treatment is done with but little supervising care. The treatment, including the small correction of the lower edge of the folded trapezium-shaped flap, is completed in twenty to twenty-five days.

The operation was first applied to a seventy-five year old man with secondary spinocellular or epidermoid cancer of the right cheek. Pictures 5 and 6 show clearly the severity of the case. The cancerous growth had extended over a large portion of the right face, including the right angle of the mouth, in the

Fig. 8

Fig. 9

Fig. 10

Figs. 8 to 10. These represent the patient already shown in figures 5 and 6, after completion of the described plastic operation. A normally wide and elastic cheek and a sufficiently wide mouth opening have been produced.

vicinity of which, according to the explanations of the patient, appeared the primary tumor which was removed several months before the appearance of the secondary growth. The growth had already penetrated inward toward the mouth cavity and outward toward the cheek. After its eradication a large cheek and facial insufficiency was left, which extended from os zygomaticum to basis mandibulae and from the right third of the mouth opening (one-third of both the lower and the upper lip was excised) to the masseter muscle (figure 7). The restorative intervention was done in the previously described method, using local anaesthetic. At the same time all regional lymph nodes were removed; some of them contained cancerous metastasis. Figure 7 illustrates the size of the skin flap obtained from the neck, after the elevation of the trapezium-shaped cutting. After covering the operative wound lying in the region under the jaw (see description of the operation) and after doing the plastic operation for widening the mouth opening, necessary in this case, the patient acquired an elastic

cheek and a sufficiently wide mouth. The final plastic and cosmetic achievement can be seen in figures 8 to 10.

SUMMARY

An operative method for restoration of a through and through cheek defect, or of a whole cheek, is described. The cheek defect is covered by means of a skin band, containing the underlying fatty tissue, possessing two nourishing bases, and equipped on both sides with normal skin. The skin-fatty band consists of the skin covering of the lower jaw and under jaw regions, and of a trapezium-shaped flap taken from the fossa carotica region. The operation is made clearer by figures 1 through 4. The following operative case, a man of seventy-five years of age, suffering from secondary spinocellular or epidermoid cancer of the cheek, is illustrated by figures 5 through 10.

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CLASSIFICATION OF MAXILLOFACIAL INJURIES[1]

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"Wounds of the face have been interesting chiefly from the rapidity with which even the most severe and dangerous looking of them heal . . . . It would be easier to say where, and how, the face has not been pierced by balls, than to enumerate the directions in which it has. The upper and lower jaws have been fractured, and large portions of them removed, yet, with few exceptions, a good recovery has followed when no other concomitant injury assisted to bring about an unfavorable issue".

These observations were made during the Crimean War by G. H. B. McLeod in his book "Notes on Surgery in War in Crimea" and published in 1862. The mechanics of war have changed since then, ninety years ago, but the same notations hold true today. Maxillofacial injuries are of great concern not so much because of the possibility of loss of life but because of the scarring and deformity which cannot be concealed.

With the completion of the Italian Campaign, a review, comprising a period of twenty months, was undertaken of the maxillofacial injuries admitted to an evacuation hospital. The work was augmented when, for a short period, we were the head center for the local British forces and for a longer period the Brazilian Expeditionary Force used the facilities of the hospital. From this study a number of observations were noted and these will be detailed in a series of papers.

An attempt will be made at this time to evaluate the maxillofacial injury, to properly classify the patient who is seen with an injury to the face and neck, of varying degree, so that despite the apparent severity of the injury we may know what clinical points to look for, what may be done for him surgically and what the prognosis will be. All this knowledge can be readily applied to civilian practice where the automobile not infrequently produces destruction similar to that seen on the battlefield, war having been once defined as an epidemic of trauma.

Attention is brought to the observation that the severe injury to the facial region does not of itself place the patient in danger. We have seen patients with fractures of practically every bone in the face plus associated severe local soft tissue injury enter the hospital as ambulatory cases. They were cooperative and required little or no preparation for complete surgical repair. Others, with apparently lesser injuries, were markedly distressed and showed altered physiological states. It is on the basis of these observations that we have made the following classification of cases admitted to the maxillofacial service.

[1] From the Michael Reese Hospital Unit, Chicago, Ill.

Group 1. Primary Maxillofacial Injuries
a. Without hemorrhage or obstruction
b. With (1) hemorrhage, (2) obstruction, or (3) both
Group 2. Maxillofacial Injuries with Concomitant Wounds

PRIMARY MAXILLOFACIAL INJURIES WITHOUT HEMORRHAGE OR OBSTRUCTION

These patients varied from those with insignificant wounds to those with extensive and serious bone and soft tissue destruction. The significant features of the cases falling into this group is that without hemorrhage and/or obstruction and no concomitant injury extensive maxillofacial injuries were noted and the patients were quite comfortable and in little need of sedation. The pulse rates, blood pressures and blood studies showed no significant changes from the apparent normal. The pre-operative preparation was minimal and we have proceeded to do one stage primary repairs in the severely injured with excellent post-operative results. Extensive surgical procedures have been undertaken such as complete intranasal reconstruction for the crushing injury of the central face region, rotation flaps to cover large defects, direct bone wiring in certain types of mandibular fractures, Caldwell-Luc procedures for antral foreign bodies, reconstruction of avulsed lips and primary closures of extensive wounds of the face and floor of the mouth. These patients tolerated the anesthesia and operation well and were usually ambulatory within twenty-four to forty-eight hours.

Case Report #1. Diagnosis: 1. Perforating wound of face, severe; 2. fracture compound comminuted maxilla, right; 3. fracture compound comminuted mandible, right; 4. laceration of tongue, severe; 5. foreign body in neck, right.

A bullet entered the right side of the face beneath the eye. It perforated the maxilla destroying the posterior part of the alveolar ridge and the adjacent tissues. It then traversed the mouth through the tongue, shattered the mandible and the missile lodged in the superficial tissue of the right neck region.

Injured: 5 March 1750 hours.

Admitted to a field hospital: 5 March 2200 hours to clear his airway which had become partially obstructed by blood.

Admitted to this hospital: 6 March 0100 hours, in good condition.

Operation: 6 March 1300 hours. Under endotracheal anesthesia multiple loop wiring was first applied to the upper and lower jaw. The oro-antral opening was debrided, loose bone spicules were removed from the antrum, mucous membrane flaps in the mouth were mobilized by undermining and the flaps brought over the opening from the antrum into the mouth closing same. The tongue lacerations were sutured and all the torn mucous membrane was approximated to seal off the mouth from the mandible. The bullet was removed from the superficial tissues of the neck through a small incision and this wound was left open. With a long sub-mandibular incision the fractured mandible was exposed and the edentulous posterior fragment was wired directly to the anterior fragment. One large completely detached bone fragment was replaced along the inferior mandibular border and held in place by suturing a flap of tissue over it. This wound was then closed in layers and one plasma tube drain placed to the fracture site. A naso-antral window was made to drain the right maxillary sinus. The mandible was supported by a four-tailed pressure bandage cut from three inch stockinette. Five hundred cubic centimeters of blood were given to replace that lost at operation. All deep tissues were closed with 3-0 catgut plain, 4-0 silk being used for the mucous membrane and skin, and 0.018 stainless steel wire for the bone wiring. On 7 March the patient was out of bed and the rubber bands were applied to the jaw wires and good occlusion was obtained. On 12 March all skin sutures and drains

were removed. On 21 March the patient was evacuated to a general hospital at which time the submandibular incision had healed, the edema of the face had disappeared and x-ray studies showed the bones to be in good position.

This case illustrates all the points noted in the *group 1* classification. Despite the severe injuries he had lost little blood and had no obstruction. The patient was ambulatory, needed no pre-operative preparation and in fact was not classified as an urgent operative problem. Extensive surgery was performed and in twenty-four hours he was up and about with a final reduction of his fractured mandible.

PRIMARY MAXILLOFACIAL INJURIES WITH HEMORRHAGE, OBSTRUCTION OR BOTH

In this group we had the same type of cases as noted previously but the clinical picture was altered when blood loss had been severe or respiratory obstruction was present, and particularly so when both conditions existed concomitantly. We noted more often the patient with the cold and clammy skin, ashen hue, rapid pulse, decreased blood pressure, dyspnea and apprehensiveness. A rapid evaluation of the cause of this state was made and measures were instituted immediately to restore the patient to a state of physiological balance. Treatment was directed at the primary cause of these conditions. Lost blood was replaced with blood, and when urgently needed, unmatched low titer "O" blood was given without reactions. Obstruction was relieved by a tracheotomy if necessary. X-ray studies were frequently undertaken after resorative measures had been administered. When the requirements of replacement of blood and the establishment of an adequate airway had been met, the patients in this group were able, to safely undergo extensive reconstructive surgery and the post-operative course was usually similar to that in the previous classification except that those patients with tracheotomies presented their own special nursing problems.

Case Report #2. Diagnosis: 1. gunshot wound of face, left; 2. fracture compound comminuted mandible, left; 3. fracture compound hyoid bone; 4. laceration trachea, severe; 5. injury to carotid artery, right; 6. bullet in supraclavicular fossa, right.

A bullet entered the left side of the face, fractured the mandible and the hyoid bone. It traversed the neck lacerating the trachea and lodged in the wall of the carotid artery on the opposite side of the neck just above the level of the clavicle.

Injured: 7 January 1300 hours.

Admitted to hospital: 7 January 1415 hours.

Operation: 7 January 1430 hours. Under local anesthesia a tracheotomy was performed. The patient was given one unit of plasma and 1000 cc of 0 9% saline solution intravenously. He was then sent for x-ray studies and returned to the seriously ill ward. The swelling in the right neck region at the site of the foreign body gradually increased. On 8 January at 0030 hours the right neck region was explored. The anesthesia was ether administered through the tracheotomy opening. The foreign body was in the wall of the right carotid artery just above the level of the clavicle. Bleeding was controlled by the use of stick sponges pressed against the artery above and below the wound level. The bullet was removed, the hole in the vessel closed with 3-0 silk, and the carotid artery was then ligated above and below the traumatized area and this segment was removed. During the operation the patient received 1000 cc. of blood. On 9 January the jaws were wired and fixed with rubber bands. Good occlusion was obtained. The tracheotomy tube was removed on 14 January. On 18 January the patient was evacuated to a general hospital without mental, cerebral or peripheral nerve changes

In this case we had to contend with the factors of both hemorrhage and respiratory obstruction. The lack of an adequate airway demanded immediate attention as can be seen from the time sequence of hospital admission and operation. With the relief of the respiratory obstruction and the restoration of fluids the patient's condition improved sufficiently to warrant the second operation within a relatively short period. By the use of multiple transfusions these patients were rapidly brought back to a state of physiological equilibrium and we were unable to note any differences in their ability to undergo extensive primary one-stage repairs or in the post-operative course as compared with similar injuries where blood loss had not been significant. Even where a tracheotomy was required we had no hesitancy to do our usual reparative surgery after only a short wait. These patients too, did very well.

Maxillofacial injuries with concomitant wounds

In this group we had the patient with damage to the maxillofacial region and with concomitant cerebral, thoracic, abdominal or extremity wounds. When there was active bleeding from the face or when respiratory obstruction existed there was never any question as to surgical priority. While the facial injury is rarely the cause of death, it is disfiguring and must not be relegated to the background despite the other wounds. Our experience was that the facial surgery added no risk to the wounded soldier with major cerebral, thoracic, abdominal or extremity injury. Immediate reparative surgery was indicated to preserve tissue, for with delay, in addition to tissue loss from the original trauma there would have been an added loss from infection and retraction and the golden opportunity to do our surgery between the stages of contamination and infection would have been lost. Early repair will minimize later deformity. Cooperation between the services made possible suitable arrangements for the anesthesia and the operation so that all the surgery could be done at one sitting. Where, due to the position of the patient, the head and neck could not be approached while other surgery was in progress the maxillofacial repair was done at the termination of the other surgery using a lighter plane of anesthesia.

Any patient with an apparently primary maxillofacial case and who exhibited restlessness, drowsiness, altered blood pressure or pulse or respiratory rate and which symptoms were not accounted for by the loss of blood or respiratory obstruction was re-examined for a concealed injury. An injury to the chest from a crush or blast or a minute wound of entrance of a foreign body may have been overlooked. A ruptured kidney may be present in a soft abdomen. The intimate relationship of the sinuses of the skull to the brain and its covering must be constantly borne in mind. Negative x-ray studies of the skull are no indication of lack of cerebral injury and it is important to remember that basal skull fractures are not often demonstrated roentgenologically. Injuries to the eyes, no matter how severe, did not affect the clinical picture of the maxillofacial injury.

Case report #3. Diagnosis: 1. fracture compound comminuted clavicle, right; 2. fracture compound comminuted scapula, right; 3. perforating wound of leg, right; 4. avulsion

eye, left; 5. fracture compound orbit, left; 6. fracture compound comminuted maxilla, bilateral; 7. fracture compound comminuted mandible, bilateral.

The patient had sustained multiple wounds. There was a large penetrating wound of the right shoulder involving the clavicle and the scapula, with a large foreign body deep behind the latter. There was a small perforating wound of the right leg. On the left side of the face a shell fragment had destroyed the eye and left maxilla. The walls of the sinus were badly crushed with entrance into the eye above, the nose medially and the mouth below. Both maxillae were freely movable. The mandible was fractured into at least four large sections. There was a loss of considerable bone and soft tissue in the chin region.

Injured: 4 January 1300 hours.

Admitted to this hospital: 4 January 1600 hours.

Pre-operative preparation: 500 cc. blood.

Operation: 4 January 1900 hours. With the patient propped up by a wood block under his shoulders, it was possible for a general surgical team and the maxillofacial service to operate simultaneously. The anesthesia was endotracheal with a nasal intubation. The shoulder wound was debrided and the foreign body removed by extending the wound of entrance. The leg wound was also debrided. The mucous membrane of the roof of the mouth was sutured to seal off the opening into the maxilla. The maxilla was packed from the outside after debridement with one inch gauze to control bleeding. The left eye was enucleated and the soft tissues about the eye were repaired. Multiple loop wiring was applied to the few remaining teeth in the upper and lower jaws. In the chin region where the mandible was completely exposed, two large bone fragments of the mandible were wired directly to each other. The tissues about the chin were undermined and then closed. All the torn mucous membrane within the mouth was closed to completely seal off the mandible from the oral secretions. One plasma tube drain was placed to the fracture site in the chin region. A plaster Velpeau dressing was then applied for the right shoulder and clavicle. As usual 3-0 plain catgut was used for buried sutures, 4-0 silk for the mucous membrane and skin, and 0.018 stainless steel wire for the bone wiring. On 8 January the rubber bands were applied to the multiple loop wiring of the jaws and good occlusion was obtained. On 17 January he was evacuated to a general hospital. The only post-operative discomforts that the patient had, and his only complaints, were centered about the shoulder.

This case illustrates a maxillofacial problem with a a concomitant injury. Combined surgery by two operative teams shortened the time of anesthesia. No time was lost in repairing the injuries about the face and it will be noted that post-operatively the severe facial injuries caused the patient far less discomfort than the fracture of the clavicle and the scapula.

SUMMARY

Patients with maxillofacial injuries can be divided into three clinical groups. In the first classification are those patients exhibiting injuries to the face and neck of varying severity but without hemorrhage or obstruction of the airways. These patients are usually quite comfortable, need little sedation and show few, if any, signs of clinical shock despite the severity of the injuries. They safely tolerate extensive primary repair of the damaged parts. In the second classification are the same type of cases but suffering from noticeable loss of blood, respiratory obstruction or both. These patients are acutely ill and present many of the manifestations of clinical shock. Treatment is directed at the relief of this latter state by the replacement of lost blood and the establishment of an adequate airway. When these criteria have been met primary reparative surgery of any degree may be carried out, as in the first group. In the third classification are

the facial injuries with concomitant cerebral, thoracic, abdominal or extremity injury. Facial surgery will not compromise the treatment of these cases and should be done concomitantly for the end results of minimal scarring and deformity. Any apparently primary maxillofacial case exhibiting restlessness, drowsiness, altered blood pressure or pulse or respiratory rate not accounted for by hemorrhage or respiratory obstruction must be examined for a concealed injury.

I wish to thank Col. Manuel E. Lichtenstein for his suggestions in the preparation of this paper.

CLEFT LIP REPAIR AFTER AXHAUSEN

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Innumerable procedures have been proposed for closure of congenital cleft lips. The older methods aimed at the closure of the defect in primitive fashion without regard of the cosmetic result. The vermilion border lining the defect edges were sacrificed and the cleft was closed by simply uniting the wound edges. Mirault was the first to utilize the vermilion border lining, thus improving the appearance of the lip. His method became more or less the basic principle for various modern procedures. The object of the latter is not only to secure a firm closure of the cleft but to correct all deformities around the cleft: The deviation of the nose, the flattened nostril, and the shortness of the lip.

Blair and Brown improved the Mirault technic in an ingenious way, and worked out a method which assured excellent cosmetic results. They also demonstrated that in through and through clefts a forceful approximation of the shaped halves of the hard palate, as devised by Brophy and others, was unnecessary, hence, so many future harmful deformities could have been avoided. Veau, who more than anyone else has stimulated modern principles in cleft lip and palate surgery, proposes a technic by which in total clefts lip and hard palate are closed in the same sitting. The utilization of a vomer turnover flap is a clever and unique scheme. The vomer flap has been welcomed by many leading authorities. Ivy and Curtis combine it with the Blair-Brown operation on the lip. I agree with W. B. Davis that simple incisions are preferred before those with "complicated geometric designs". I also agree with Axhausen that the closure of the hard palate at the time of the lip repair is not an advantage, since it increases the operating risk and does not simplify the later palate repair.

Axhausen, going out from basic modern principles as outlined by Blair and Brown, Veau, and others, aimed at simplifying the incisions and developed a technic, which—from personal experience in thirty-six patients with various types of lip clefts—I can highly recommend. Axhausen published his monograph in Germany during the war. Only a very few of those have reached this country. Hence, his method is practically unknown in the United States The purpose of this article is to give an evaluation of the method and to recommend it to those interested in cleft lip surgery for further trial. The technic will be described for the most common deformity, the unilateral through and through cleft (unilateral lip, alveolar process, palate cleft, Group III after Ritchie). The operation is performed between the 6th and 8th week after birth, if the child is gaining weight and is healthy. A careful preoperative examina tion and evaluation of the child's condition is imperative. Axhausen recommends local anesthesia; I prefer ether vapor administered through a sterile ether hook held in the angle of the mouth.

The repair is divided into the following stages:

1. Formation of the floor of the nostril.
2. Correction of the alar displacement.
3. Correction of the septum displacement.
4. Closure of the lip.

1. Formation of the floor of the nostril (Fig. 1–3). The floor of the nose is reconstructed only anteriorly, i. e., not further back than just behind the alveolar process. It is constructed by utilization of turn-over flaps, taken from the median and lateral walls of the cleft. The cleft behind the alveolar process remains open untii the palate is repaired.

The first step consists in formation of the median turn-over flap. With a retractor, the nostril is lifted forward and an incision is made just behind the rim of the columella from its tip to the ridge of the alveolar process. The knife

Fig. 1

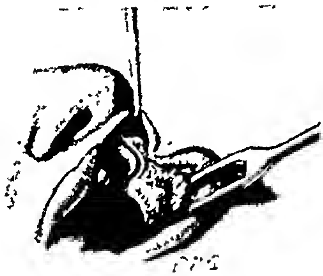

Fig. 2

Fig. 1. Formation of the median turnover flap (redrawn from Axhausen, G.: Technik und Ergebnisse der Lippenplastik G. Thieme, Leipzig, 1941).
Fig 2. Formation of the Lateral Turnover Flap (redrawn from Axhausen, G.: Technik und Ergebnisse der Lippenplastik. G. Thieme, Leipzig, 1941).

is now turned horizontally and the incision curved around the alveolar process ending posteriorly where premaxilla and vomer meet (fig. 1). The mobilization of the flap is difficult; it should be carried out under sharp dissection, avoiding perforation of the flap and injury to the septal cartilages. The flap should not be extended further posteriorly than to the groove which is formed by the insertion of the vomer to the premaxilla; (otherwise the flap will tear at this point and may need replacement by a small turn-over flap from the vomer).

Formation of the lateral turn-over flap is the next step. This step is combined with an incision along the gingivo-labial sulcus and mobilization of the soft tissues of the cheek (fig. 2 and 3). The incision starts at the edge of the alveolar process and is led to the point where alveolar process, tip of ala and vermilion border meet, and from there upward into the nostril (fig. 2). The location of this latter part of the incision, the nostril incision, is important; if it is too close to the rim of the nostril, the nostril will be weak and collapse when rotated. If it is too far posterior, it will make the nostril too bulky. As

a rule, the incision should be made so that it is one-quarter anterior to the mucous membrane skin line, and three-quarter skin lining of the nostril is left in front of the incision.

The cheek is mobilized from an incision along the lateral gingivo-labial sulcus leaving a rim of mucous membrane attached to the gingival side to facilitate later suturing (fig. 3). With a sharp periosteal elevator, the soft tissues of the cheek are mobilized until the nasal bone and the foramen infra-orbitale, i. e., the infra-orbital nerve are reached. Hemorrhage is controlled by pressure.

The lateral turn-over flap is now formed by freeing the tissues from the edge of the alveolar process upward, beyond the lower tubinated bone.

Median and lateral turn-over flaps are now united with sutures of 00000 Chromic catgut. The lower suture is left long for later use.

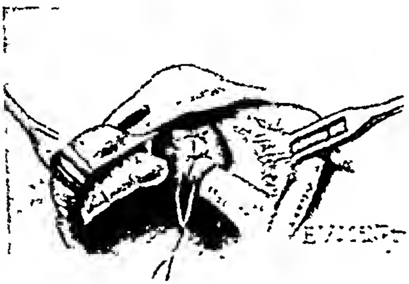

Fig. 3

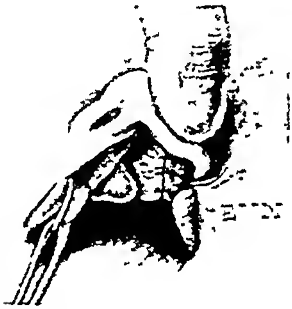

Fig. 4

Fig. 3. Both Turnover flaps are sutured together to form the floor of the nostril. (Redrawn from Axhausen, G.: Technik und Ergebnisse der Lippenplastik. G. Thieme, Leipzig, 1941.)

Fig. 4. Formation of the alar flap and of the median vermilion border flap (redrawn from Axhausen, G.: Technik und Ergebnisse der Lippenplastik. G. Thieme, Leipzig, 1941).

2. Correction of the alar displacement: For the formation of a well-formed nostril, it is necessary to mobilize the laterally displaced ala and to unite its tip with the columella of the septum at the site of the tuberculum. At this particular place, the recipient site is already prepared. It is the wound which has resulted from turning over the median flap for formation of the floor of the nose (fig. 1 and 3). To facilitate smooth approximation of ala and recipient site, the tip of the ala is mobilized in form of a small flap. There is usually a small portion of skin available median to the tip. This, however, is not sufficient. The flap must be made longer. Its posterior (inner) edge is already made, resulting from turning over the lateral nostril flap (fig. 2). Hence, only the anterior (outer) incision needs to be added. It starts at the point where the tip of the ala and lateral vermilion border lining join each other (fig. 4), and proceeds upward and lateral along the base of the ala for about one cm. After anterior and posterior incision have been connected with each other, the small ala flap is mobilized and sutured into the upper wound angle of the columella;

the posterior edge is sutured to the median and lateral turn-over flap; the anterior edge to the outer wound edge of the columella (fig. 5). Care should be taken to unite the tip of the ala with the tuberculum of the columella The place of the tuberculum can easily be found. it is the point where the line along

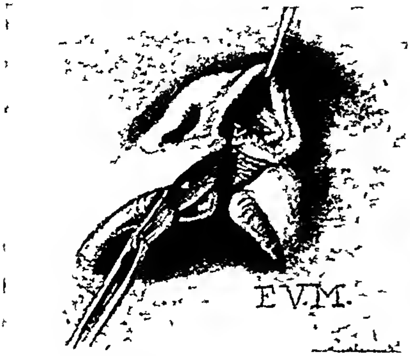

FIG 5

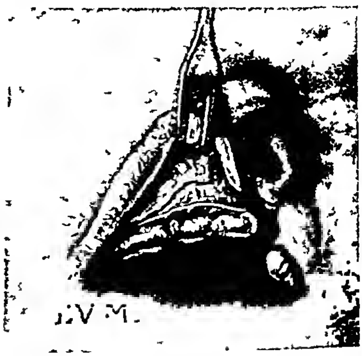

FIG 6

FIG 5 The alar flap is sutured to the columella and to the lateral turnover flap (redrawn from Axhausen, G Technik und Ergebnisse der Lippenplastik G Thieme, Leipzig, 1941)
FIG 6 Correction of septum displacement by mobilization of the tissue median to the cleft (redrawn from Axhausen, G Technik und Ergebnisse der Lippenplastik G Thieme, Leipzig, 1941)

FIG 7

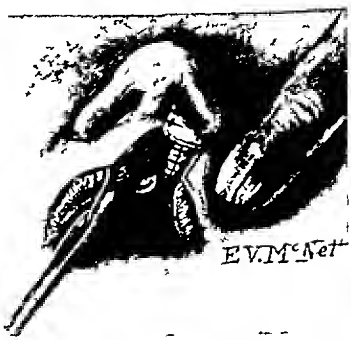

FIG 8

FIG. 7 Lateral advancement of the lip median to the cleft (Redrawn from Axhausen, G. Technik und Ergebnisse der Lippenplastik G Thieme, Leipzig, 1941)
FIG 8 Formation of the lateral vermilion border flap (Redrawn from Axhausen, G Technik und Ergebnisse der Lippenplastik G Thieme, Leipzig, 1941)

the median vermilion border lining (muco cutaneous junction) would intersect the outer wound edge of the columella Its location can be facilitated by forming the median vermilion border flap before adjustment of the ala This is done as follows: An elastic clamp is applied to the right side of the upper lip to reduce bleeding While the displaced upper lip is pushed with a finger into correct position, the "bow of the cupido" (juncture of philtrum with the muco cutaneous

border of the vermilion) becomes visible, at least its point opposite to the cleft. If the corresponding point at the cleft is not visible, it is imagined near the vermilion border in the same level as the other point and marked with a drop of methylene blue, inserted intracutaneously. From this point, an incision is made upward and parallel to the muco-cutaneous junction just within the skin

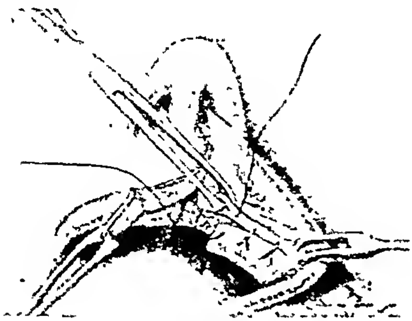

FIG. 9

FIG. 10

FIG. 9. Median advancement of the lip lateral to the cleft. (Redrawn from Axhausen, G.: Technik und Ergebnisse der Lippenplastik. G. Thieme, Leipzig, 1941.)
FIG. 10. Closure of the lip in layers. The muscle suture is tied posteriorly.

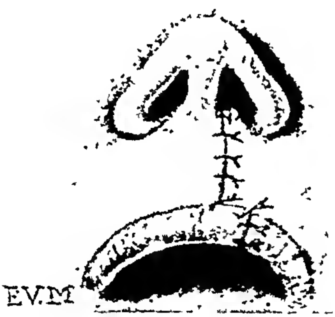

FIG. 11. To counteract notching of the vermilion border at the point of approximation the vermilion border is sutured at a different level than the skin by reducing the vermilion border flap on the lateral side and making the median vermilion border flap longer.

line until the incision meets the outer wound edge at the columella. This is the point of the tuberculum which also is marked with a drop of methylene blue. The tip of the vermilion border is now grasped and a whole thickness vermilion border flap cut down to the first marker. The ala flap can now be accurately adjusted as described above (fig. 5).

3. Correction of the septum displacement: The extra median displacement of the septum is corrected by advancement of the mucous membrane along the

median gingivo-labial sulcus. An incision is made along the sulcus, care being taken to leave a rim of mucosa attached to the gums to facilitate later suturing (fig. 6). The soft tissues are mobilized from the bone until the cartilaginous septum and the floor of the nose is reached. The mobilized mucosa is now

Fig. 12 a. Complete cleft lip and cleft of the alveolar process. No cleft of the palate Operation seven weeks after birth.

Fig 12 b Eighteen months after operation

advanced laterally by pulling it with a forceps in that direction and fastened in this position with silk sutures (fig. 7).

4. Formation of the lip: Prior to the closure of the lip cleft, a vermilion border flap must be made from either side of the cleft. The median one is already formed. The lateral one is made in a similar fashion as the median flap after application of an elastic lip clamp (fig. 8). The length of the wound edge of the

skin should equal that on the median side. A mosquito hemostat is applied to the tip of each flap for traction.

Advancement of the mucosa along the lateral gingivo-labial sulcus is the next step which is done in a way similar to that on the median side (fig. 9). The lateral and median wound edge are united in front of the alveolar process cleft and to the floor of the nostril.

The lip is sutured in three layers. The muscle layers are united first (fig. 10). To prevent inversion of the skin edges, the latter are mobilized from the muscles for a short distance. Three catgut sutures are usually required to approximate the muscles. The lowest one should be placed exactly in level of the mucocutaneous junction of the lip. The skin edges are united with fine silk sutures.

á b

FIG. 13 A. Unilateral total cleft of lip and palate. Operation six weeks after birth: Closure of lip and alveolar process.
FIG. 13 B. Child nine months after the operation.

The vermilion border flaps are severed at their base and the resulting wound edges united with fine silk sutures. The lowest silk suture is left long to retract and evert the lip which facilitates the exposure and suturing of the vestibular mucous membrane.

Variation: The author follows Axhausen's technic in most details. However, the retention suture which Axhausen uses (similar to Veau's technic) has not been successful in our hands. It often gave way too early. We found Blair-Brown's nostril retention suture a more reliable and more efficient method in holding nostril and lip together. I also do not tie the sutures of the labial muscles in front, but posteriorly and have not observed a stitch abscess since. Fine cotton sutures are used for all buried sutures. To counteract notching of the vermilion border at the point of approximation, the vermilion border is sutured at a different level than the skin. This is accomplished by reducing the length of the

vermilion border on the lateral side and making the vermilion border flap of the median side longer or vice versa, depending upon the discrepancy of width in the two sides (fig. 11). If the nostril is too flat, a crescent piece of skin and

Fig. 14 a. Bilateral total cleft. Closure of left side five weeks after birth, and that of right side nine weeks after birth.

Fig. 14 b. One year after the operation

cartilage is removed from the alar-columellar junction followed by skin suture prior to the insertion of the retention suture.

In complete lip clefts, (the alveolar process is closed, Group I of Ritchie's classification) the cleft involves lip and floor of the nostril. The technic does not differ much except that the alveolar process does not require closure, and formation of the floor of the nostril needs a minor modification. The technic is also similar for closure of bilateral total clefts. The vermilion border of the

philtrum should be preserved since the philtrum if placed in anatomical relation will greatly help the development of the anatomy. This has often been emphasized by Warren B. Davis. The premaxilla must be retrodisplaced only in cases where the cleft is very wide and the premaxilla shows extensive anterior displacement. This is best done with an oblique cut through the vomer about 1.5 cms. posterior to the maxilla after H. S. Vaughan. A similar technic is

A B

FIG. 15 A. Secondary deformity after cleft lip and cleft alveolar process repair. Communication of nose and vestibulum, lateral displacement of the ala. Scars of upper lip with notching of vermilion border.

C

FIG. 15 B and C. Four weeks after correction

used in the repair of secondary deformities of those cases which exhibit all four characteristic deformities, namely, downward displacement of nostril, laterally displaced ala, extra-median position of the septum, and a connection between nasal cavity and vestibulum oris (fig. 12–15).

Conclusion: Axhausen's method of cleft lip repair is described, which is based on firm closure of the cleft and correction of the deformities around the cleft, namely, deviation of the nose, flattened nostril, and shortness of the lip. The

repair is divided into formation of the floor of the nostril, correction of ala displacement, correction of septum displacement, and closure of the lip. It is applicable to all types of lip clefts, also applicable in the repair of secondary deformities following primary repair of lip clefts.

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SUBSTITUTION OF THE CHISEL FOR THE SAW IN RECONSTRUCTIVE SURGERY OF NOSE

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With the method commonly in practice today, much time and energy are unnecessarily consumed and undue trauma is produced in the removal and readjustment of the excess bone structure in the operation for reconstruction of the oversized nose. This, in the opinion of the writer, can to a great extent be overcome if the chisel is substituted for the saw. The procedure herein

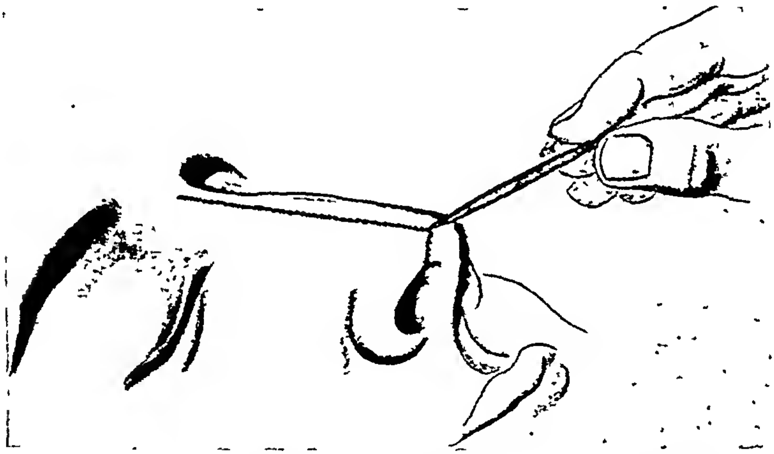

FIG. 1 SKIN SURFACE MARKED TO OUTLINE DESIRED HEIGHT OF BRIDGE AND LENGTH OF NOSE.

presented should effect the gross reduction in the size of the bony and cartilaginous parts with a saving of time and effort and pave the way for the refinement of technique which is subsequently required. Only a brief outline of text is necessary to make clear the fundamentals of the procedure about to be described as the accompanying illustrations should adequately serve to reenforce and elucidate the subject matter.

PRELIMINARY PROCEDURE

The skin of the nose is marked to indicate the desired height of the bridge and the amount of shortening required (fig. 1).

Anesthesia is produced with novocain solution 2% containing ten drops of adrenalin 1–1000 to the ounce. The skin of the dorsal and lateral regions

repair is divided into formation of the floor of the nostril, correction of ala displacement, correction of septum displacement, and closure of the lip. It is applicable to all types of lip clefts, also applicable in the repair of secondary deformities following primary repair of lip clefts.

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of the nose is infiltrated. The membranous and cartilaginous nasal septum and lateral nasal walls are also injected (fig. 2).

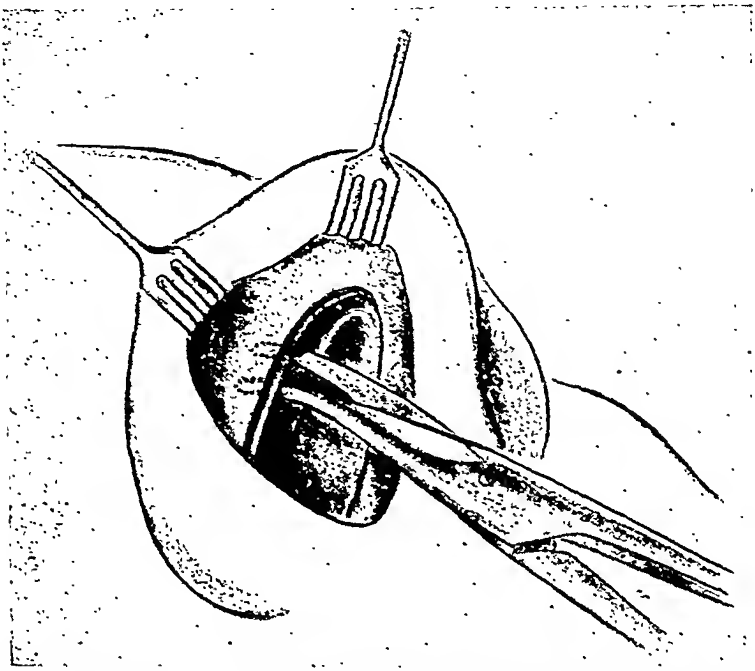

Fig. 4. Separating upper and lower lateral cartilages from overlying skin to permit mobilization of these cartilages and the subseouent removal of certain portions of them.

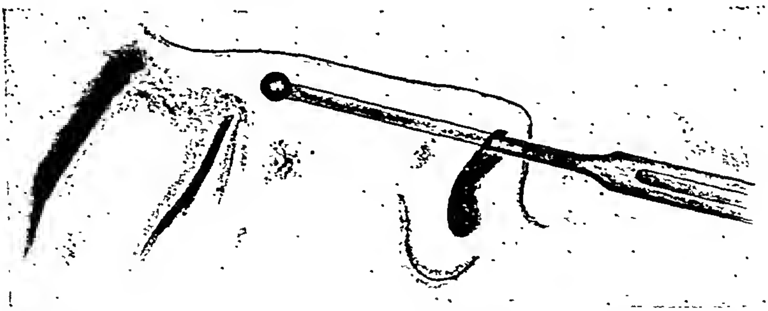

Fig. 5. Elevation of periosteum and overlying skin from lateral and dorsal regions.

Hot, sterile compresses of normal saline solution (temperature 115° to 120° F.) are applied to the skin of the external nose for five minutes. This will be materially effective in the control of troublesome bleeding.

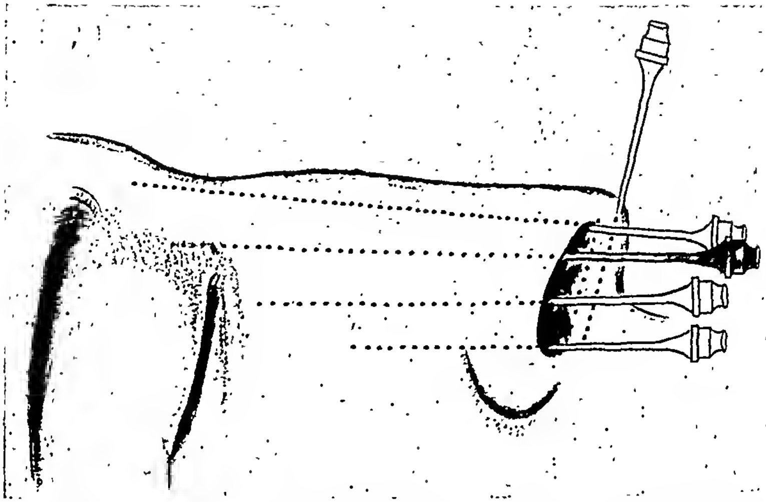

FIG. 2. Skin infiltration with novocain solution. The membranous and cartilaginous nasal septum and lateral walls are also injected.

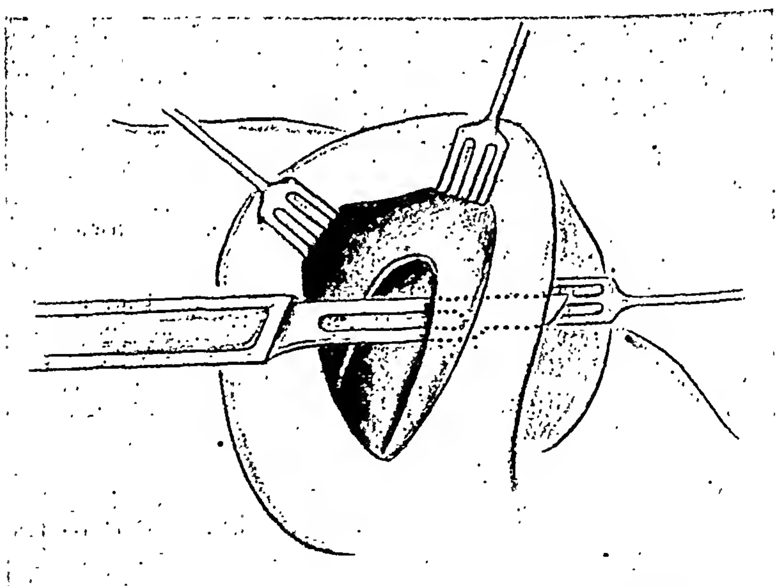

FIG. 3. Incision of aponeurosis connecting upper and lower lateral cartilages with extension of incision downward dividing membranous columella from anterior cartilaginous septum.

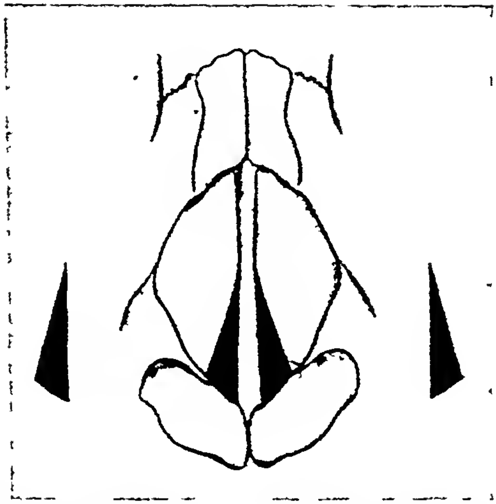

FIG. 8. Dark area on each side of septum indicates site of removal of triangular strip of upper lateral cartilage

FIG 9 SMOOTHING DOWN BONY SURFACE OF DORSUM WITH RASP

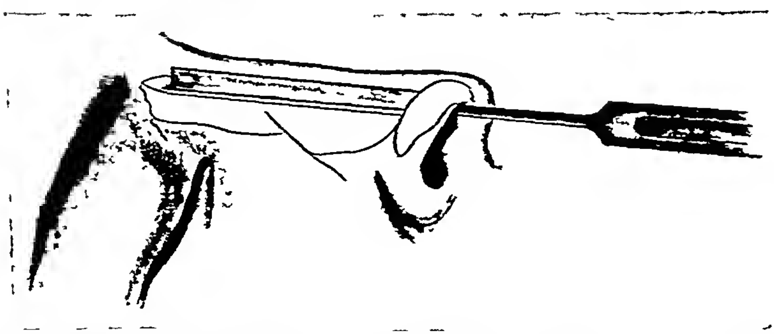

FIG 10 Separation of nasal bone from bony nasal septum and excision of radix nasi to narrow entire length of bridge (after Aufricht)

OPERATIVE APPROACH

With a #15 Bard-Parker blade, an incision is made in the aponeurosis connecting the upper and lower lateral cartilages The incision is continued down-

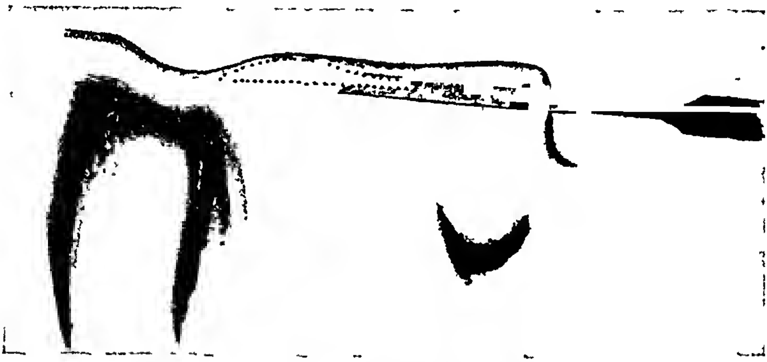

FIG 6 REMOVAL OF DORSAL ELEVATION WITH CHISEL

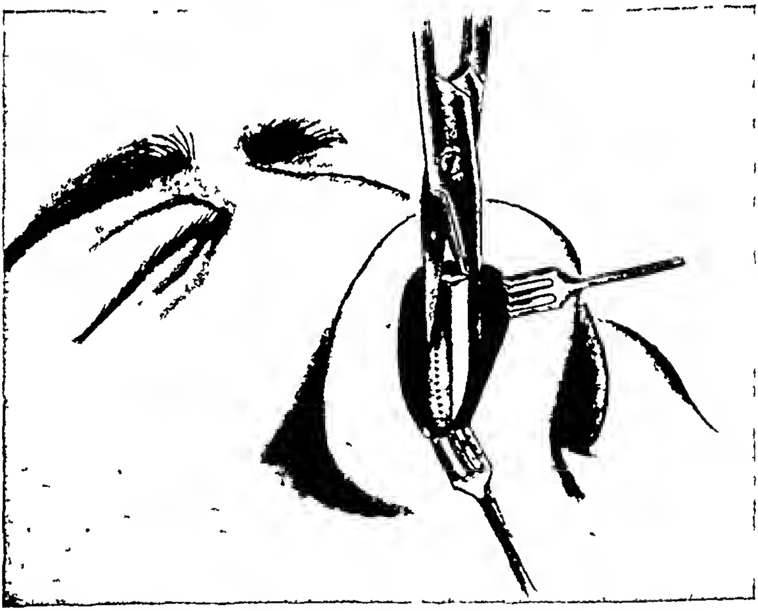

FIG. 7. EXCISION OF ANTERIOR PART OF SEPTUM TO SHORTEN NOSE

ward separating the anterior part of the cartilaginous septum from the membranous columella (fig. 3). A small curved Mayo scissors is placed in the incision dividing the upper and lower lateral cartilages and the overlying struc-

tures are thoroughly freed (fig. 4). This will allow mobilization of the tip region, using a periosteal elevator after the pattern of a mastoid curette (writer's design)

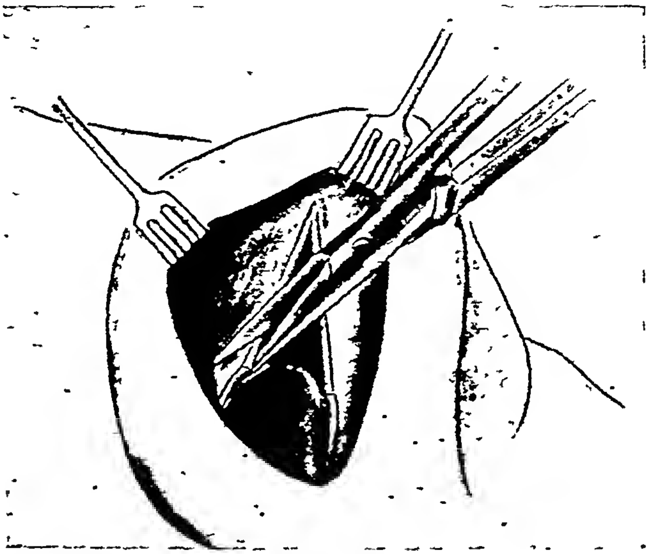

FIG. 13. Upper border of lower lateral cartilage is trimmed to further reduce alar perimeter.

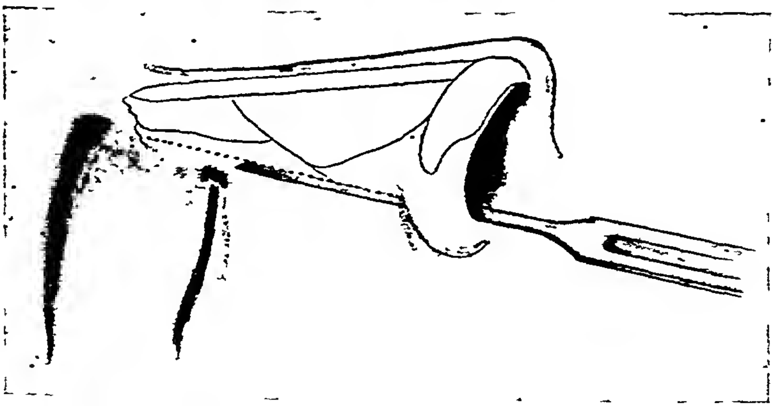

FIG. 14 LATERAL OSTEOTOMY FOR PURPOSE OF NARROWING BASE OF NOSE

the bone covering with its overlying skin is gently detached from the lateral and dorsal regions of the nose, proper care being taken not to lacerate the periosteum (fig 5) A wide chisel (15 to 17 mm.) is employed to excise the excess

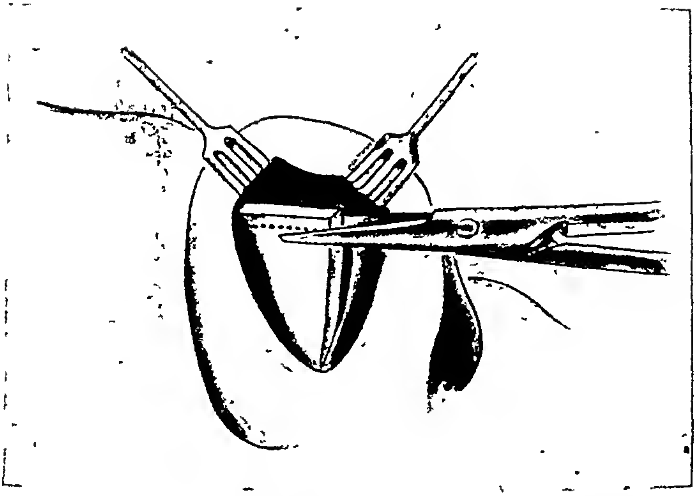

FIG. 11. REMOVAL OF UPPER BORDER OF CARTILAGINOUS SEPTUM

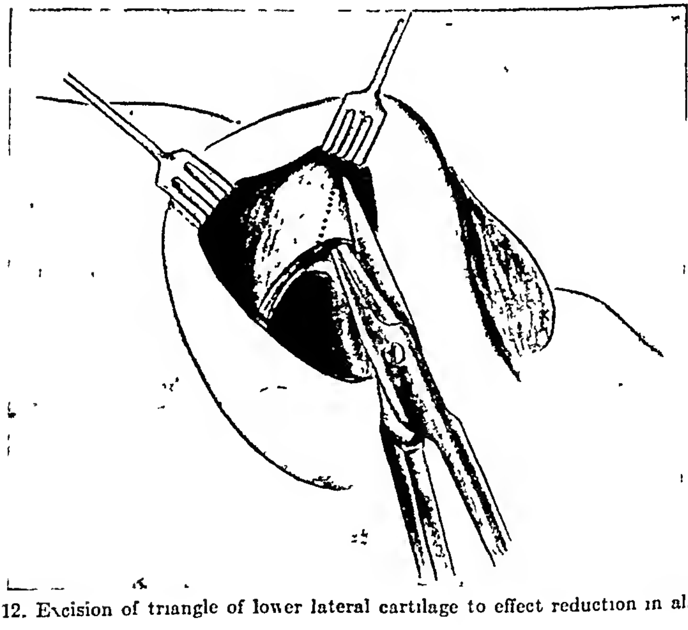

FIG. 12. Excision of triangle of lower lateral cartilage to effect reduction in alar perimeter.

permit narrowing and slight shortening of the nose in this region (fig. 8). The bony dorsum may require leveling with a rasp and this should be accomplished

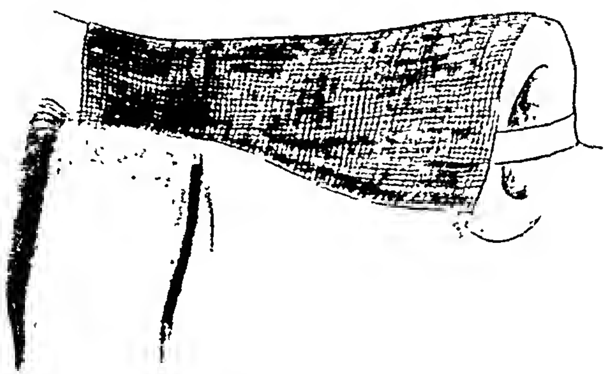

FIG. 17. Vaseline gauze covers adhesive strips. This prevents adherence of adhesive to splint which is subsequently applied.

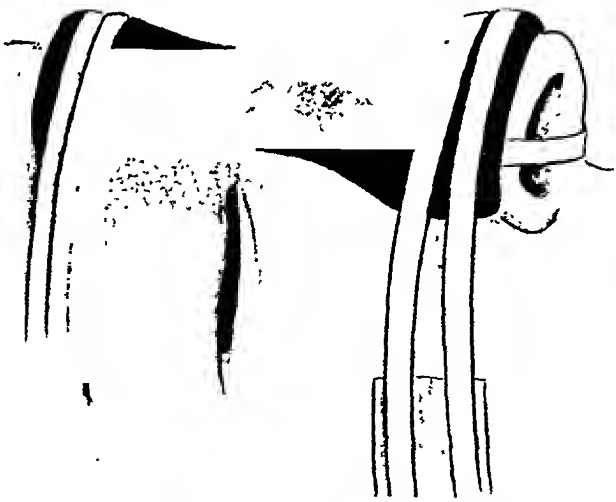

FIG. 18. Immobilization of reassembled structures with splint which is securely confined with adhesive tape.

with precision and gentleness of technique to avoid injury to the upper portion of the cartilaginous septum (fig. 9). A chisel is employed to excise the radix nasi to narrow the entire length of the bridge after the method of Aufricht (fig. 10).

cartilaginous and bony dorsum. This reduces the height of bridge (fig. 6) To shorten the nose the elongated nasal septum is trimmed at its lower border

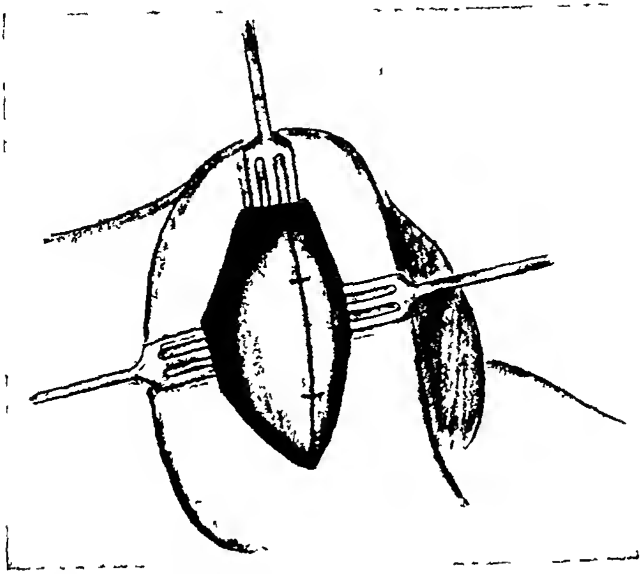

FIG. 15. CLOSURE OF MEMBRANOUS COLUMELLA AND SEPTUM

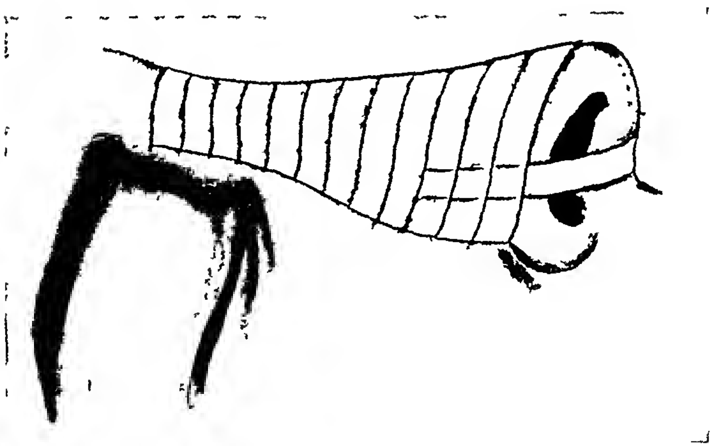

FIG. 16 USE OF ADHESIVE STRIPS TO CONFINE SKIN TO ITS UNDERLYING STRUCTURES

with a strong straight scissors and the excess nasal spine, when present, is eliminated with a chisel (fig. 7). The upper lateral cartilage is severed from the nasal septum and a segment of the cartilage (triangular in shape) is removed to

ANOTHER EXTERNAL NASAL SPLINT

J. G. HEBERT[1], M.D.

Montreal, Quebec

One hesitates to foist upon the profession another external nasal splint but with the Canadian rehabilitation program bringing us a lot of service men wishing correction of pre-enlistment or service-acquired nasal deformities, and an increasing embarrassment with the splints currently in use, the development of another splint was the natural course of events.

Four types of nasal deformity were coming into our hands in fairly large numbers. First, the typical hump nose, which we corrected in the usual manner with bridgecrest and lateral saw cuts, infracture and shortening by removal of columellar and lateral cartilage. Second, old fractures with characteristic lateral zig-zag deformity requiring complete refracture and mobilization of the bony structure. Third, the acute nasal fracture which was not infrequent from accidents in district military manoeuvers or off-duty altercations. Fourth, the saddle nose, of which our staff has completed quite a series using mostly carved cancellous iliac crest grafts of the "strut" or "keel" types.

We felt that each of these types of reconstruction did better with a snug. external type of nasal splinting and that the requirements of such splinting were: (1) That it should be reasonably simple in application, (2) That it should grip the external nose snugly over most of its dorsum and nasobuccal angles to minimize postoperative swelling, (3) That it should exert pressure downwards and inwards at the nasobuccal junction, (4) that it should have a universal joint over the bridge to render it independent of forehead scalp movement and (5) that it should preferably derive its base of counterpressure from the occiput, rather than the forehead.

With these provisos in mind and good plaster bandage, the spring of a large safety pin and the fundamental parts of a mouse trap as materials, the present splint was devised. It is composed of three parts: an around the head plaster cast, a light plaster mold, light enough that it does not completely defeat the spring of the large safety pin, and a spring action device bridging the plaster head cast and the nasal mold.

The mechanical part of the splint has been, at present, made up as follows (see fig. 1): a tin forehead plate (A), measuring approximately two inches by four is curved on its length to fit the forehead. The mid part of each border of this plate is turned up as in (B) to give more purchase in the plaster. On the convexity of the plate, at the union of the upper two-thirds with the lower one-third, two small flaps (C) are raised about $1\frac{1}{2}$ inches from each other. These are punctured in their centers (D) so as to hold the catch of the mouse trap (E) complete with its spring (F). On the distal bar of the catch is fixed the mouse trap cheese-holding piece (G). The small hook (H) on this piece is curved to

[1] From the Plastic Service of John Gerrie, M.D., Montreal Military Hospital.

Using scissors, the upper border of the cartilaginous septum is lowered to bring this structure on a level with the bony dorsum (fig. 11). With scissors, remove a triangle of the lower lateral cartilage to reduce the alar perimeter (fig. 12). Excision of a portion of the remaining upper border of this cartilage will further reduce the width of the tip (fig. 13).

A strong chisel, 6 to 8 mm. in width, is placed in the vestibule of the nose lateral to the floor where the chisel is made to engage the nasal process of the maxilla. From this point, the chisel is driven to the nasofrontal suture line. This severs the bone at the nasofacial angle. The external nasal walls can now be pressed medially and this maneuver will result in a narrower nose at its base (fig. 14).

The membranous columella and septum are closed and the nasal cavities are lightly packed with vaseline gauze (fig. 15).

Adhesive strips are applied in the manner shown (fig. 16). Vaseline gauze is placed over the adhesive strips to prevent adherence of the adhesive to the splint which is subsequently applied to immobilize the reconstructed parts (figs. 17 and 18).

COMMENT

It is noted that the procedure followed does not include the little refinements of technique which are often required to produce the desired end result. The description given mainly deals with the gross removal and readjustment of the oversized bony structures which can, in the judgment of the writer, be more readily and effectively accomplished with the chisel than with the saw.

The advantages of the chisel may be summed up as follows:

1. There is a definite saving of time and energy.
2. The severed bone surfaces are left smooth and clean.
3. There is less trauma to the soft tissues.
4. There is no bone dust to produce osteogenesis.

hold loosely the spring of a large size safety pin (I) the two free extremities of which have been cut off and the remaining tips curved forwards (J).

As soon as the corrective surgical procedures are completed, a thin plaster mold is placed over the reconstructed nose. Three or four layers of a substantial mesh plaster bandage, preferrably Cellona, cut to pattern, as shown in fig 2, are allowed to set while being held in proper molding form by the operator's fingers. This plaster mold should cover the glabella, but should not go down as far as the tip of the nose. It is important to overlap the nasobuccal angles and go well down toward the inner canthi.

A head plaster band is made, in the same manner as for other facial splinting purposes (fig. 2), care being taken that its anterior lower border runs over the

FIG. 3

FIG 4

FIGS 3 AND 4. "MOUSE-TRAP" EXTERNAL NASAL SPLINT IN POSITION

eyebrows. On the anterior part of this plaster band the frontal plate of the splint is fixed by means of a few plaster strips, its lower border juxtaposed to the head band lower border. During this procedure, the mouse trap catch, released from its spring (fig. 2-A), and the safety pin should be lying flat on the nasal plaster mold and absolutely in line with the bridge of the nose.

When the plaster strips are set, the spring is re-apposed to the catch which is then raised forwards and the safety pin brought back to an angle with it, so that the curved extremities of the pin are placed on the sides of the nasal plaster mold (fig. 2), directly over the lateral fracture lines, where they are held in place with small bits of mesh plaster.

The splint can be left in position as long as ten days without any complaints from the patient, except for some itching under the head plaster band. There are minimal lateral movements because of the firm base procured by the head

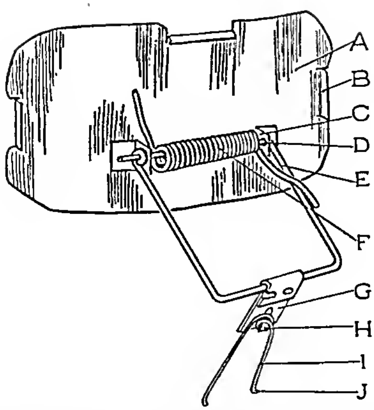

Fig. 1. (A) Tin forehead plate. (B) Turned up borders for purchase in plaster. (C) (D) Flaps raised from the plate. (E) Mouse-Trap catch with its spring (F). (G.H.) Mouse-trap cheese-holding piece bridging a large size safety pin (I.J.) to the catch. See text for way of applying splint.

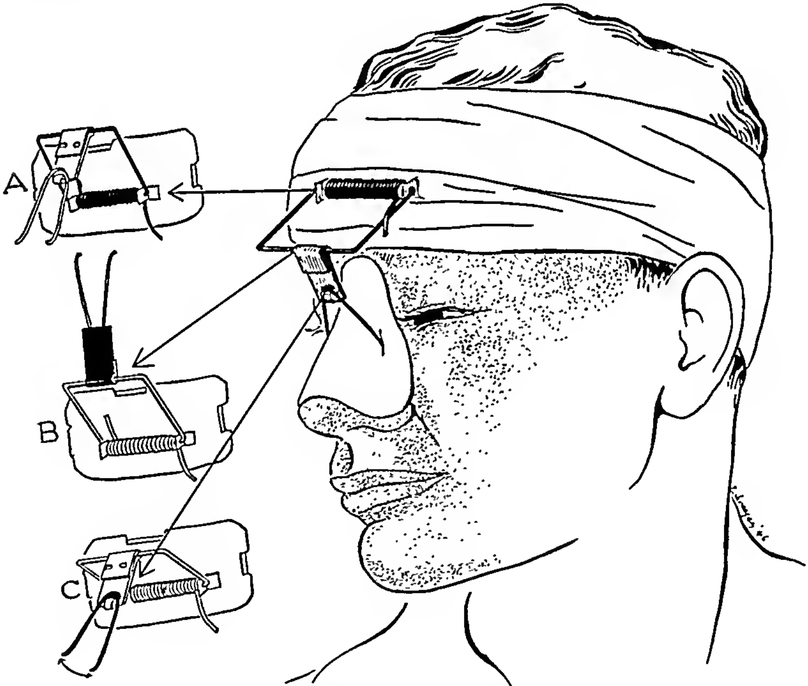

Fig. 2. The larger drawing shows the splint in position. The three diagrams on the left show the range of mobility of the splint. In (A) the catch of the trap is raised up by releasing the spring. (B) shows the cheese holding piece turned up on the distal bar of the catch, and (C) demonstrates the lateral movements of the safety pin. (B) and (C) form aa universal joint.

MODERN EXPERIENCES WITH TUBED PEDICLE FLAPS OF THE THIGH

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AND

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INTRODUCTION

The tubed pedicle flap method of transferring soft tissues from one part of the body to some distant site has had frequent mention in the literature of the past thirty years. However, there is a paucity of material dealing with tubed pedicles of the thigh. It is likely that tubed pedicles in this region would never have been used widely were it not for the advent of the technic of grafting the underlying defect. This technic has been described in another paper from this plastic surgery clinic[1]. The width of the thigh tube is greatly limited when the resultant defect is closed directly, since it is impossible to close a space of more than two inches (5 cm) in the average thigh. A flap this narrow is difficult to form into a tube and is impractical for all except small wounds. However, when the grafting technic is utilized, as large a tube may be formed on the thigh as elsewhere on the body.

GENERAL CONSIDERATION

When treating deformities of the lower extremities that cannot be suitably covered by direct pedicle flaps, the thigh tube holds several advantages over tubed pedicles that require an intermediary host, or "carrier", such as the hand or arm. They are: (1) Treatment using the more distant tube calls for at least eight separate operations, while the thigh tube requires a maximum of five. Allowing three weeks between stages, the use of the thigh tube shortens the procedure by more than two months. (2) When the hand is used as a carrier, it is necessarily attached to the tube for at least three months. As a result, the patient does not have the use of the hand for that period. (3) When tubed pedicles are "waltzed" to the defect, without the aid of a carrier, even more time is necessary, with the added danger of tissue loss. (4) There is less morbidity associated with the thigh tube flaps, due to the elimination of at least three operations and the need for an intermediate carrier. (5) Probably the most important advantage is the elimination of possible infection and necessary scarring of the normal hand or arm that would serve as a carrier.

* Formerly Lt. Colonel, Medical Corps, Army of the United States.
† Formerly Major, Medical Corps, Army of the United States.
[1] The Split Thickness Graft a Useful Adjunct in Tubed Pedicle Preparation, Macomber and Patton, Jan. 1947 S G & O.

band and these are absorbed by the universal joint at the level of the safety pin attachment to the distal bar of the mouse trap catch (fig. 2, B, C.)

If interim examination of the reconstructed nose becomes necessary, the nasal piece can be raised with a flip of the fingers and again flipped back into the same exact position. It is removed in a week or ten days during which time it seems to have effectively controlled postoperative swelling and the nasobuccal swelling so bothersome in nasal reconstruction.

We realize this splint is a bit Goldbergian in its construction and application and an effort is being made to have its fundamental parts made in simple materials that will be acceptable to the profession.

SUMMARY

An external spring-plaster nasal splint is described. This adequately fills the splinting requirements of most nasal injuries and reconstructions as described in paragraph three.

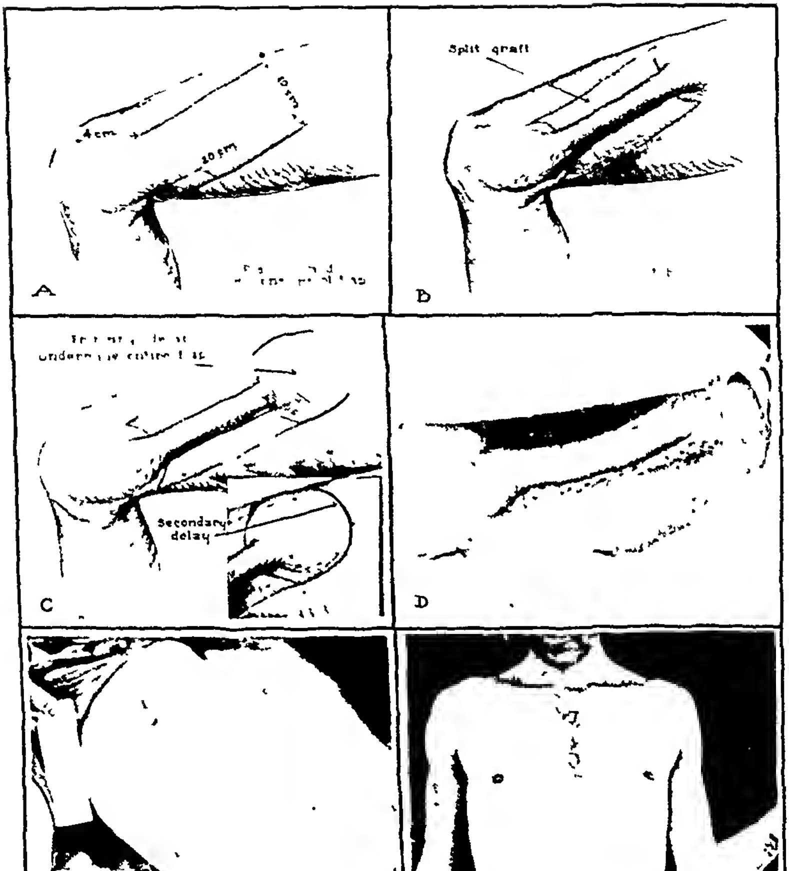

PLATE I

A. Position and dimensions of flap. Distal incision at least 4 cm. from upper border of patella. B. Completed tube ready for pressure dressing. C. Description of primary and secondary delays. D. Healed tube ready for primary delay, approximately 3 weeks after its formation. Tube formed for defect in Plate II, A. E. Completely delayed flap, ready for transfer. F. Healed split graft donor site on chest. Same patient as shown in Plate II, D and E. Transverse abdominal scar is where a long tube was formed at another institution and almost completely lost.

INDICATIONS

Prompt healing with a minimum of scarring is essential in plastic surgery. The attitude in this clinic is to plan all procedures so that the operative site in each individual stage will be closed at the time of the operation, to allow healing per primam. This accounts for the formation of a great many tubed pedicles by this service.

Many battle casualties present defects of the lower extremities that cannot be properly covered by flap shifts or direct pedicles for various reasons: (1) There is often inadequate or unsuitable nearby tissue to effect a closure by flap shifting; (2) the injured limb may require transfer of a large amount of soft tissue, not only to replace the existing scar, but to relax the remaining skin and subcutaneous tissue and bring in additional blood supply so that the limb may "breathe" normally; (3) the scarred areas may be large and extend over two or more surfaces of the limb, rendering their coverage by direct pedicles impractical; (4) the mere position of many wounds makes the use of methods other than tubed pedicles technically impossible.

The main disadvantage of tubed pedicles as compared to direct pedicles or flap shifts is that more time is required to form, delay, shift and divide a tubed pedicle. However, when the length of time required to obtain a completely healed wound with a soft, pliable and adequate flap by the latter methods is considered, it is found that the difference in actual time is not a great factor.

TECHNIC

The flap to be tubed is planned obliquely on the thigh so that the distal end is on the medial aspect of the thigh, above the knee, and the proximal end on the anterior surface of the upper thigh. This position takes full advantage of the flat medial surface of the inner thigh and facilitates tubing of the flap (Plate I A and B). The greater saphenous vein may be divided when the tube is formed or at the time of one of the delays of the flap. No deleterious effects have been noted as a result of the interruption of this vessel. It is unwise to make both parallel incisions until the flap is completely undermined through one and the width of the flap found adequate to form the tube[2]. It is easier to begin the dissection from the lateral incision, since the line of cleavage is more definite in this region.

The width of the flap is usually dependent upon the dimensions of the defect to be covered. However, in obese individuals, the flap may be necessarily wider than required by the defect so that the tube may be formed. The flap must be short enough to maintain an adequate blood supply, yet long enough to transfer. Thigh tubes were made one and one-half times as long as they were wide; eg, 18 x 12 cm. or 15 x 10 cm. Since tubing a flap reduces its length twenty-five to thirty percent, it is advantageous to make the flap twice as long as it is wide; eg, 24 x 12 cm. or 20 x 10 cm. These latter flaps will result in tubes about 19 and 15 cm. long.

[2] Tubed Pedicle Complications in Repair of Massive Tissue Defects, Macomber and Rubin, Plastic and Reconstructive Surgery, Jan. 1947.

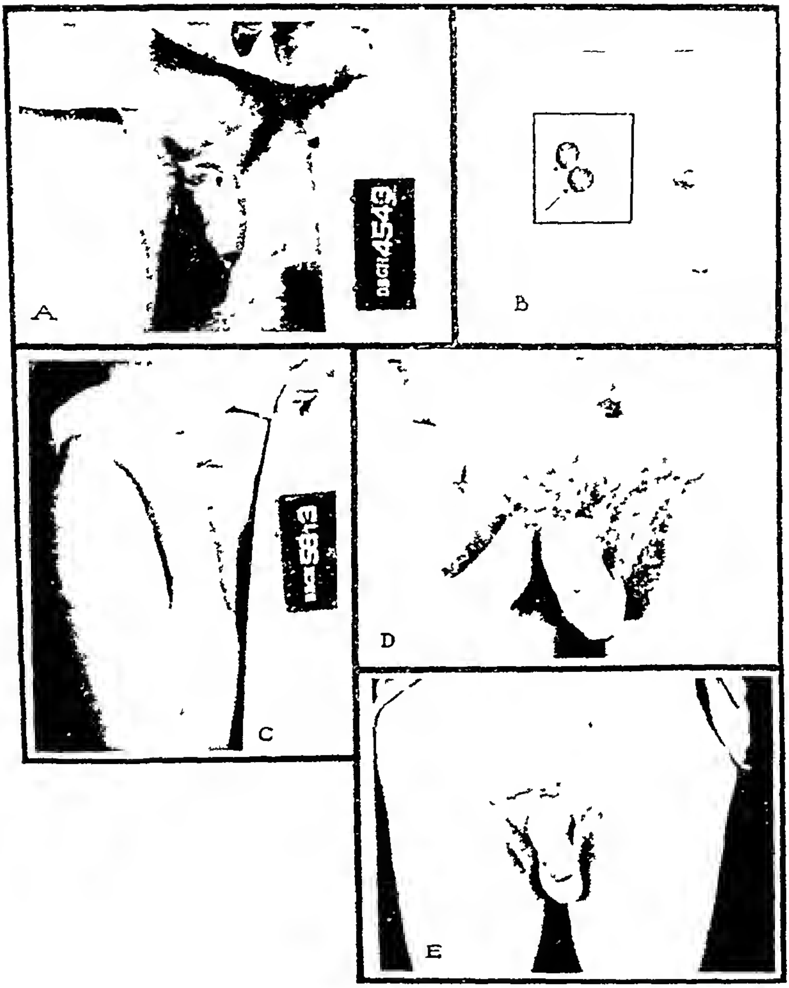

PLATE III

A Urethral fistula with marked scarring and contracture of penis Suprapubic tube in situ B Sketch showing position of double barrelled urethral fistula C Healed thigh tube ready for primary delay D Completely healed transferred flap Urethral fistula and suprapubic cystostomy closed Patient voided normally 20 days after flap was transferred E Penile and thigh operative sites healed per primam following division and revision of tube pedicle

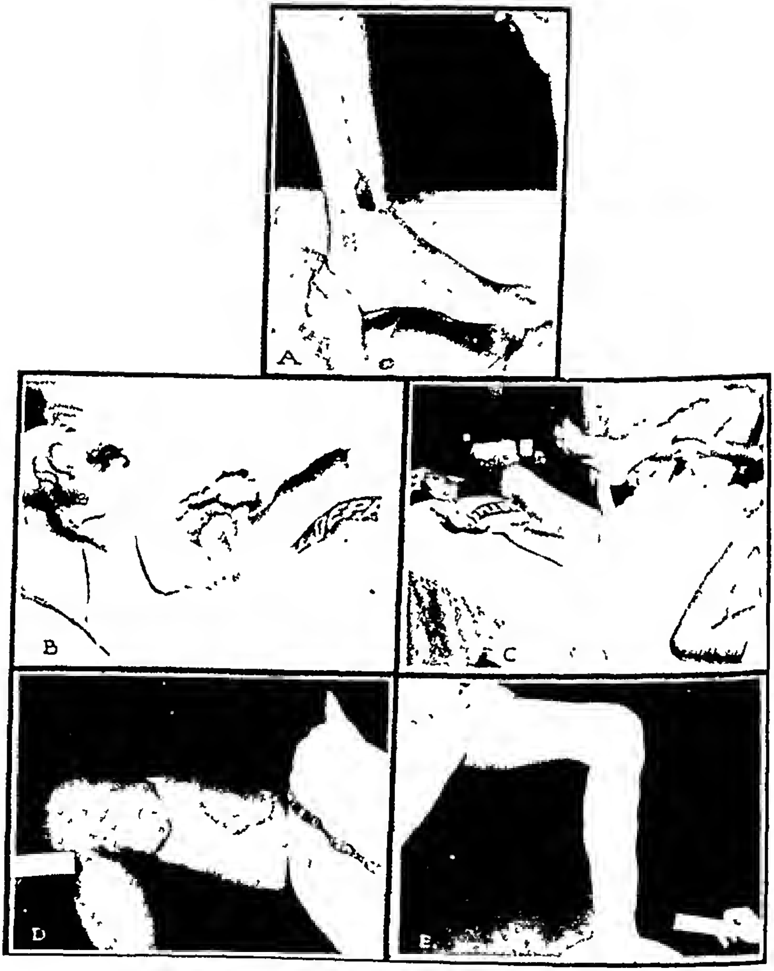

PLATE II

A. Typical defect requiring covering of normal skin and subcutaneous tissue prior to bone grafting. B. Transferred tubed pedicle flap to large defect of heel. Lower extremities immobilized in cross-legged plaster spica. C. Healed flap attached to heel and ready for division. D Typical healed thigh donor site. Central portion covered with portion of split-skin graft applied when tube was formed. Proximal perforated split-skin graft applied when delayed flap was transferred. Distal portion covered with remainder of tube which was opened and returned to its original bed. E. Healed transferred, divided and revised flap over leg defect. Same case as shown in Plate I, F and Plate II, D. Long scar above and below knee is where a second long tube was formed at another institution and most of it was lost due to faulty planning and disregard of surgical principles.

The tube per se may be used to fill the defect. However, in large defects or in multiple transfers, the flap on the tube is essential. A flap on both ends of the tube in conjunction with the tube may be necessary to furnish adequate tissue for the defect. These flaps may be lifted safely after primary and secondary delays (Plate I, C). When it is necessary to use flaps on each end of the tube, it is wise to fashion them approximately equal in size. This is due to the fact that some time during the transfer, one flap must live on the blood supply picked up by the other. Thus, a large flap will fare poorly if dependent upon a small flap attachment for its nutrition.

Any unused portion of the tube still connected to the thigh can be opened and sutured into its original bed (Plate II, D).

The flap may be lifted from the distal (direct) or proximal (retrograde) end of the tube with impunity after adequate primary and secondary delays have been accomplished. The rich anastomoses about the knee has proven adequate to carry a large retrograde flap. In fact, it has been found that the retrograde flap is the more practical, since it is more easily transferred to most defects below the mid-portion of the opposite thigh.

TABLE 1

Number of Patients admitted		2,593
Number of Tubed Pedicles made		259
Tubed Pedicles of Thigh	102	
Thoraco-epigastric Tubed Pedicles	98	
Thoraco-epigastric tubed pedicles for leg defects with hand as carrier 19		
Neck Tubed Pedicles	47	
Neck-Chest Tubed Pedicles	10	
Arm Tubed Pedicles	2	

REPORT OF A CASE

O. J. P., a 29 year old sergeant, was wounded in action on 9 April 1945. A .31 caliber rifle bullet perforated the right buttock, traversed the perineum, scrotum and right shaft of the penis and divided the right spermatic cord.

The patient was admitted to this hospital on 11 May 1945 with a markedly scarred, partially amputated penis, absence of right testicle and a urethral fistula. The bladder was emptied through a suprapubic cystostomy.

On 7 September 1945 a tubed pedicle, 9 cms wide and 13 cms long, was formed high on the right thigh (Plate III, C). A flap, 9 cm x 9 cm, was primarily delayed on 12 October 1945 and secondarily delayed on 3 November 1945. On 1 December 1945 the urethral fistula was closed, the scar dissected from the penis and the flap transferred to the penile defect. The wound was well healed and the patient was able to void naturally in approximately three weeks, (Plate III, D). The suprapubic catheter was removed on 9 January 1946 and the tube was detached on 8 February 1946. It was necessary to circumcise the patient to eliminate a fistula under the prepuce. This last operation was done on 30 March 1946.

SUMMARY

During the two years, from April 1944 to March 1946, there were 2593 patients admitted to our plastic surgical center. These individuals presented the

IN MEMORIAM

John Staige Davis

On December 23rd, 1946, at twilight, Dr. John Staige Davis died in his sleep. His day's work was done and his labors were over. Death came a few days before he was to have been honored at a dinner on his seventy-fifth birthday.

He was probably the first physician to devote his entire practice to plastic surgery, and he played a major part in developing this branch of surgery as a specialty. Despite little encouragement, he persisted in the belief that it was necessary to devote all of one's time to master both the treatment of wounds and the varied operative techniques required for the repair of congenital and acquired deformities occurring from the top of the head to the sole of the foot. To this end he fitted himself for his lifework by his own laboratory research, by reading extensively the reports of operations and the clinical observations of his predecessors and contemporaries. He travelled widely in this country to observe plastic operations.

With his growing clinical experience, acquired the hard way without a teacher and during a period when there was little or no remuneration for his efforts, he began writing prolifically of his methods and observations. He was the author of over seventy papers or monographs on clinical or experimental subjects. He wrote, and in 1919 published his book, "Plastic Surgery." This was profusely illustrated by photographs of his own cases and by drawings made by his wife Kathleen Gordon Bowdoin, whom he married in 1907. It covered the literature with a voluminous bibliography, and was a critical work which gave the author's opinion in the light of his own experience concerning the value of various operative procedures. This volume was for years the outstanding textbook on the subject of plastic surgery and stimulated many surgeons to an interest and proficiency in this field.

He developed and popularized the small deep skin graft. By this easily-acquired technique a large number of general surgeons throughout the world were enabled to cover with skin the granulating areas of ulcers and extensive burns and thus to speed the healing of these open wounds which were so often debilitating and of long duration. The fact that this method has largely been supplanted by more refined methods does not detract from the great part this type of graft played in saving lives and hastening convalescence.

He was a great champion of the "Z" plasty and not only used this method frequently to advantage, but both spoke and wrote repeatedly on the value of this procedure and its application for special conditions.

He was somewhat of a prophet in his own country in that his own medical school, Johns Hopkins, from which he was graduated in 1899, for many years gave him no support commensurate with his unique place in this special field of surgery. As a result the training of plastic surgeons there was delayed and

usual wide variety of deformities and defects seen in the casualties of modern warfare.

In order to return the injured parts to as near normal as possible, it was necessary to make use of most of the principles and technics of plastic surgery. In so doing, a total of 259 tubed pedicles were formed (table 1). Of this total, 102 (39%) were tubed pedicles of the thigh, whereas the thoraco-epigastric tubes (with the hand as a carrier) were used in only 19 (7%) of the cases. In many instances, the transferring of tissue was required before any bone grafting, tendon or nerve repair could be accomplished. The successful use of thigh tubes in 39% of our patients who required tubed pedicles indicates, in our opinion, that this method will supplant the longer and more hazardous "carrier" tube method of correcting deformities on the lower limbs.

most patient in discussing their problems and aspirations, giving freely of his knowledge and stimulating them to improve their standards and ideals.

In addition to other medical societies, he was a member of the National Research Council, the Interurban Surgical Society, the American Society of Plastic and Reconstructive Surgery and was President of the American Association of Plastic Surgeons from early in World War II until a few months before his death. He was a past President of the Southern Surgical Association and a past Vice-President of the American Surgical Association. He was a founder member of the American College of Surgeons, and just before his death was elected to the Board of Regents of the American College of Surgeons.

He was a founder and member of the American Board of Plastic Surgery, being its chairman from its inception in 1937 until the year before he died. As such he exerted a strong influence in raising the standards of this specialty in North America. At the time of his death there were over 150 diplomates of the Board in this country, many times more than the number of such specialists in any other country.

In addition to his widow, he left a daughter, Mrs. Charles E. Scarlett, Jr., and two sons, William Bowdoin, until recently a major on the Plastic Surgery Section of the Valley Forge General Hospital, who will carry on his father's practice in Baltimore, and Howland Staige, formerly a lieutenant commander in naval aviation.

Dr. Davis was born in Norfolk, Virginia, and possessed the grace and charm of a true southern gentleman. There were several doctors in his family bearing the same name. With his patients, as well as in his other relationships, he was kindly, reassuring, and imparted confidence, yet he did not hesitate to stand up for his convictions and could be righteously indignant and outspoken if need be. His ideals were of the highest and he acted accordingly.

Plastic surgery owes a great debt of gratitude to John Staige Davis and the influence of his life will be felt in the years to come.

JEROME P. WEBSTER, M.D.

undeveloped in comparison with that of other schools which recognized the need for such training.

JOHN STAIGE DAVIS, M.D.

Dr. Davis received high recognition in the surgical world. Surgeons came from many countries to talk with him and observe his work. He was always

and "Biological Flaps" in which he recommended the use of flaps based on vascular pedicles without skin.

Having completed his work on the war mutilated in Central Europe, Esser abandoned active surgical work and devoted most of his time to the projected organization of an International Plastic Center to be called "Esser Institute for Structive Surgery". He was promised official support for this Institute

JOHANNES FREDERICK ESSER, M D

which was to become a teaching center and offer training to young surgeons. It was his great dream, which never materialized; for as with all such dreams, whether fostered by genius or the common man, practical realities and human weaknesses were overlooked.

In 1940, he came to the United States. Many in the medical profession were curious and skeptical of such individualism. Most of us remember the

JOHANNES FREDERICK ESSER (1877–1946)

On August 9, 1946, a renowned pioneer in plastic surgery, succumbed in Chicago at the age of sixty-nine. The name of Esser is familar to the surgical profession all over the world and in particular to those engaged in the practice of plastic surgery.

Esser was born in Seiden, The Netherlands, on October 13, 1877. He studied in Leiden and Utrecht and received his medical degree in 1903. His early medical career was varied and unsettled, the natural result of a restless mind seeking fulfillment of its dreams. For a time he traveled in the capacity of a ship's physician and then returned to his native land to practice in a small Dutch town. Shortly afterward, he left for Amsterdam, where he practiced medicine for about ten years. For a time, we see him extending his activities to the field of dentistry, an interest which must have helped him later in the development of the inlay graft.

An illuminating background to his professional life, was his interest in chess which brought him the Amateur Championship of Holland in 1912. He was an ardent student of art, undoubtedly a contributing factor to his keen interest in reparative surgery.

Realizing the importance of surgical training to attain his ambition, Esser abandoned his practice and devoted a few years to surgical training in France and Holland. When World War I broke out in 1914, at the age of thirty-seven, he offered his services to the Austrian Government and soon was entrusted with the organization of an Army Plastic Center in Brunn.

Plastic surgery at that time was officially nonexistent. Although an ancient art extensively represented in medical literature, it was sparsely practiced by the medical profession at large. The great variety of injuries inflicted by the war and requiring reparative surgery found the surgical profession unprepared. Esser threw himself with untiring energy and skill into this "No Man's Land". The numerous atypical individual problems challenged his ingenuity; and before the war ended he had performed many thousands of plastic operations. Along with Lexer, Joseph, Morestin and Gillies, he was recognized as one of the leading reconstructive surgeons, and to him was assigned the organization of plastic centers in Budapest, Vienna and later in Berlin. For years after the end of the war, he was still engaged in this work in the Veterans' Hospital of Berlin—Templehof.

It was in 1922 that I had occasion to follow a series of lectures which he held at the Frederick-Wilhelm Academy. He was an interesting informal lecturer and philosophical in his expositions.

Dr. Esser was a prolific writer and published a great number of original articles. Among his writings, three outstanding monographs were translated in many languages: "The Esser Inlay", dealing with the method of skin grafting of cavities; "The Rotation of the Cheek" designed to cover large facial defects;

March 1947

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ABSTRACTS OF CURRENT LITERATURE

EXPERIMENTAL WORK

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In this study by Mandl and Rabinovici 21 references in the literature are quoted to show that up to the present day skin cannot be transferred from one human subject to another with a reliable prospect of "taking." The statement is made that real success was only reported after the transfer of skin of new-born babies to adults (Schoene, 1912) and, further, in identical twins.

The authors report a single case in which following an amputation *en guillotine* above the knee six pinch autografts were applied to a portion of the clean granulating wound of the stump, while six (homo) pinch grafts were applied from a 41-year old unrelated individual of the same blood group to an adjacent portion of the same wound. Both sets of grafts were "takes." In all respects except one the homografts acted similarly to the autografts during a period of fifty days.

address which he presented before our Society. In meeting him we could not help but like him.

Esser's creative original mind is no longer with us but his great accomplishments will remain on the pages of the history of plastic surgery forever.

May his soul rest in peace.

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This exceptional feature was the failure of epithelization of the homografts to proceed outward toward the periphery of the wound while the peripheral epithelium was spreading inward toward the grafts.

"Microscopic Appearance": After 43 and 50 days respectively specimens of the homografts were excised. Microscopic sections showed "the grafts integrated with the host organism but sharply demarcated towards the periphery by a barrier of lymphocytic infiltration and newly formed distended capillaries." There was no indication of structural changes; in fact, by means of special stains the elastic fibres were shown to be of normal structure.

Mandl and Rabinovici state that the reasons why the transplantation of pinch homografts was successful in this particular case are unknown to them.

Another set of homografts applied to the same wound from the same donor as before disintegrated completely in 4 days. This led the authors to conclude that the degree of immunity in the recipient to further homografting is probably more marked after the first "take" has been successful.

Chandy, Jacob: The Fate of Preserved Heterogeneous Grafts of Fascia When Transplanted into Living Human Tissues. *Surg. Gynec. Obst. 83:* 145, Aug. 1946.

The importance and significance of the use of heterogeneous preserved fascia, especially in plastic surgery, have commanded the attention of many investigators. Chandy transplanted alcohol preserved ox fascia into human tissues and removed the grafts for microscopic examination at intervals up to 4 years following transplantation. He noted that the preserved fascia rapidly became adherent to the human tissues with minimal cellular reaction. The ox fascia, however, was gradually replaced by the ingrowth of fibroblasts and capillaries and the formation of human connective tissue. This process was still incomplete, however, after 4 years. The importance of preserved fascia lies in the fact that it can be used in various plastic surgery procedures as a framework into which normal tissues may grow. It has sufficient vitality to serve in place of normal tissues for long periods of time, and it rapidly becomes firmly attached to these tissues in man.

Editorial Comment: The fate of preserved ox fascia transplanted into human tissue is apparently similar to that of preserved isogenous cartilage grafts. In both instances the dead cells in the graft structure are absorbed and the intercellular substance is slowly invaded and replaced by ingrowing host connective tissue. Evidently the nowliving collagen material which comprises the bulk of ox fascia is well tolerated by human tissues.

Living autogenous fascia, which is readily available, is a more desirable type of grafting material for most plastic procedures.

BURNS AND SHOCK

Walker, J., Jr.; Saltonstall, H.; Rhoads, J. E., and Lee, W. E.: Toxemia Syndrome after Burns: Biochemical and Pathological Observations and Studies. *Arch. Surg., 52:* 177, Feb. 1946.

As pointed out by Walker *et alii*, burn toxemia should be distinguished from burn shock; it does not necessarily postulate the circulation of an actual toxin but conveniently describes the symptom complex which occurs. In the early cases studied, the patients who were treated by tannic acid showed greater liver damage than those treated with petrolatum gauze. The other tanning agents—silver nitrate, gentian violet medicinal and triple dye—stood midway in noxious influence on hepatic function. The functional and histologic damage to the liver is usually mild, however, if tanning agents are not used, but this has produced no pronounced reduction in mortality. Survival and the extent of the burned area are closely correlated.

When the use of tanning agents was given up, with less evidence of hepatic impairment, the evidence of renal injury became more evident. Toxic nephrosis was a constant part of the picture of toxemia in fatal cases. The urea clearance frequently fell below 10 per cent of normal, and elevations of plasma non-protein nitrogen above 100 mg. per hundred cubic centimeters were observed only in fatal cases. Sixty to 80 per cent in the non-protein nitrogen was due to an increase in the undetermined fraction

not explainable on the basis of renal damage alone. During the first week after a burn, the rise in this undetermined fraction indicates the presence and severity of toxemia.

The importance of damage to the central nervous system with degeneration of ganglion cells and edema, predominantly in the hypothalamus and cortex, is stressed. However, burn toxemia is a widespread phenomenon involving many, if not all, of the organs and tissues, for which no specific treatment is as yet known.

Walker, J., Jr.: A Study of the Azotemia Observed after Severe Burns. *Surgery, 19:* 825, June 1946.

In a series of 100 cases of burns studied by Walker the plasma non-protein nitrogen rose to above 100 mg. per cent in 8 patients, all of whom died, with symptoms of toxemia noted in 7 patients. Non-protein nitrogen determinations in severe thermal burns have shown marked azotemia which has paralleled the clinical signs of burn toxemia; this may be valuable as a criterion of burn toxemia and its severity. This rise in non-protein nitrogen is due chiefly to an increase in an as yet undetermined fraction. There was an increase in the excretion of urinary non-protein nitrogen, with 30 to 50 per cent of the increase due to the undetermined fraction, but despite severe histologic changes in the kidney tubules, these patients did not die primarily of renal failure. That kidney damage is unlikely as the cause of death in burn toxemia is suggested by the generally increased urinary output when the occasional increase in blood urea nitrogen was not proportional to the rise in undetermined nitrogen.

Finland, Maxwell; Davison, Charles S., and Levenson, Stanley S.: Chemotherapy and Control of Infection among Victims of Cocoanut Grove Disaster. *Surg. Gynec. Obst. 82:* 151, Feb. 1946.

In this series of cases of burns reported from the Boston City Hospital, a total of 76 patients received sulfonamide therapy, chiefly sulfadiazine by oral administration. Systemic chemotherapy was given to control infection of the surface burns and the respiratory tract, but administration was complicated by the presence of shock and inadequate urinary output. The period of treatment with adequate doses averaged 11 days, and toxic effects were comparatively mild. *Staphylococcus aureus* infections of deeply burned areas predominated; consequently in this series it was not possible properly to evaluate the effects of the chemotherapy. On the whole, however, it was considered that the chemotherapy was responsible, at least in part, for minimizing pulmonary infection and for preventing delayed deaths from pneumonia in many cases.

Urkov, Joseph C.: The Critically Burned Patient. *Am. J. Surg., 71:* 242, Feb. 1946.

A general practical clinical outline for the overall management of the critically burned patient includes technics effective in both military and civil practice. Urkov advocates rapid and minimal débridement, with bacteriostatic pressure dressings, and emphasizes the value of massive doses of plasma and adequate electrolyte intake in combatting shock. During the period of toxemia, granulation and sepsis, adequate use of whole blood transfusions is stressed, with the maintenance of the nitrogen balance and the administration of penicillin for sepsis. Homografts can be used as dressings in selected critical cases, and initial dressings are changed only after 10 days. A "new" type of strip graft to insure maximum utilization of a dermatome graft is illustrated.

Editorial Comment: When a dermatome graft is cut into eight 1-inch strips and each attached to the adjacent strip by a series of loop sutures to permit stretching for increased surface coverage, this procedure hardly justifies credit as a new type of skin graft. Far more practical is the cemented film method described by J. P. Webster, with the variation shown by Hardy and McNichol, or the newer dermatape method presented by Reese.

Bettman, Adelbert G.: Causes of Death in Burned Patients. *Am. J. Surg., 71:* 26, Jan. 1946.

In a series of case reports, the causes of death in 24 patients, or 3.1 per cent, of a total of 778 burns, are discussed by Bettman.

This low death rate is attributed to the proper use of tannic acid and silver nitrate with immediate and continued drying; a treatment which the author feels merits a high place in the treatment of burns. "There is a chemical combination between the tannic acid and the fluids on the surface, and a second combination between the silver nitrate and the first combination." The author recognizes the evidence of liver damage following injection of tannic acid into muscle, but claims that "the tannic acid, silver nitrate and surface fluids are fixed in an insoluble, irreversible, indigestible matrix, and nothing is absorbed." As further proof of no absorption is the fact that the author observed no urinary suppression or albuminuria under this treatment when grease or oil had not been applied either as a treatment or as the burning agent. Three patients who recovered, with 80 per cent or more burned area, are considered as having been saved by prompt application of a treatment which stopped the fluid loss and fluid shift at once. The causes of death listed in the severe burns include sepsis, aphthous stomatitis, shock, lack of nursing care, being moved without shock treatment, administration of too much morphine, age and extent of involvement.

Editorial Comment: The excellent results reported in this series undoubtedly reflect the author's careful personal supervision and study of each case, but also fine general supportive therapy. In view of substantiated reports of local tissue and liver damage by different methods of tannic acid application, we doubt whether this method should be preferred without further controlled clinical evaluation and experimental proof.

SKIN GRAFTS

Conway, H., and Coldwater, K. B.: Principles in Reparative Plastic Surgery. *Surgery 19:* 437, Apr. 1946.

This report by Conway and Coldwater covers 468 secondary closures, 306 split skin grafts and 28 procedures involving the transplantation of flaps of skin and subcutaneous tissue. Skin grafting was employed more frequently in the care of older wounds. Wounds of more than 4 weeks' duration were less suitable for closure because of retraction of skin and induration for a considerable distance around the wound margins. Secondary closure was avoided in regions of the elbow, the distal third of the forearm, the hand, groin, knee, the distal third of the leg, the ankle and foot.

The wounds on admission were of 5 to 60 days' duration. The wounds that had had frequent change of dressing were in better condition than those that had been packed with vaseline gauze. Wound flora was studied. Culture of wounds showed *B. proteus*, *B. pyocyaneus*, and staphylococcus rarely. *C. Welchii* was found in 37 clinical cases of gas infection and as surface contamination in 128 wounds in 4,040 old battle casualties. Infection with beta hemolytic streptococci was the largest single cause of complete or partial failure of split skin grafts. This could be controlled by penicillin. *B. pyocyaneus* was controlled by the use of acetic acid dressings which did not jeopardize the "take." In 43 cases in which *C. Welchii* was recovered 40 perforated grafts took completely. Tropical climate influenced tho preoperative treatment because cornified layers of epidermis are thin, and deeper layers are hydropic and immature. The epithelial detritus piles up duo to the proliferative activity of the stratum germinativum, and if occlusivo dressings, particularly grease dressings, were used folliculitis and impetigo developed. Therefore, dressings of azochloramid, 1:3300, were changed at 4-hour intervals. If these were irritating, saline dressings and diluted potassium permanganate were used for treatment of dermatitis. If in 138 wounds treated with penicillin, packs were changed at 24-hour intervals there was an increase in growth of gram-negative organisms. Consequently the treatment was abandoned except in beta hemolytic streptococcic cases, where it was definitely beneficial.

Preoperatively plasma proteins and blood were normal. If streptococci were a contaminant, administration of sulfadiazine and penicillin was instituted.

Vitamin C levels in 57 per cent of 171 cases in which vitamin determinations were made, were below the normal of 30 mgm. per

cent and apparently not an influential factor in wound healing in this type of case.

Excess granulation tissue was removed in 42 wounds, and grafts were applied to granulation tissue directly in early wounds. Stainless steel or tantalum sutures were used. The skin grafts, except the 15 instances in which the dermatome was used, were held in place by single layers of gauze mesh anchored to surrounding skin by collodion. Sometimes the extremity was immobilized in plaster, but the grafted area was exposed to air for 2 to 6 hours and then saline dressings were applied and changed every 4 hours. Gauze anchorage was removed on the fifth or sixth postoperative day. It separates easily and after this the wound was exposed to air for varying periods of time. A plaster cast was used in 201 grafts to the extremities. Frequent inspection of the wounds postoperatively with evacuation of the blood clots and release of undue tension was regarded as of extreme importance by the authors.

Of 306 patients in whom split skin grafts were used, 52 had small grafts of the hand and foot; and 16 had burn wounds. Third degree burn of the ear was not included. In these cases immediate grafting was undertaken. One hundred and eight wounds were associated with fractures, 40 wounds with exposed bones, 38 with exposed tendon, 55 with draining sinuses and 14 with pyarthrosis and 43 with gas infection or gangrene. Complete healing occurred in 86.6 per cent, partial failure in 6.9 per cent and complete failure in 6.5 per cent. Small deep grafts were used over small irregular indurated lesions in the groin, popliteal areas, antecubital fossa, bony prominences such as the malleoli, patella, acromion, olecranon, foot and hand. The grafts were cut about 7 cm. in diameter.

Editorial Comment: This is an extremely interesting analysis of cases and observations on factors influencing the "take" of a graft. Although the tropical climate influenced the treatment, many observations should find practical application in the United States. The findings substantiate our observations in regard to local dressings of penicillin and relative to the organism that is most frequently the cause of failure in skin grafting.

Gordon, Stuart, and Warren, Rupert F.: Reflex Vasodilatation in Tubed Pedicle Skin Grafts. *Ann. Surg. 3:* 436, Mar. 1946.

In making use of various types of pedicle grafts, as pointed out by Gordon and Warren, the surgeon's concern is not infrequently aroused over the jeopardized blood supply to the transplanted tissue.

Localized application of heat to the body surface produces reflex vasodilatation in remote bodily sites. This principle and its possible use in encouraging circulation in tubed pedicle grafts are considered in the authors' investigation and report.

The method of study: Tubed pedicle grafts in three stages of "migration" were used, viz.: (A) those the ends of which had never been detached, (B) those having had one end detached, and (C) those having had both ends detached. By use of a thermocouple, repeated skin temperature readings were taken on the pedicles and on distant "control" skin areas, before, during and after application of heat to a remote part. (For the application of heat, a hand and forearm or a foot and leg were simply immersed in hot water, 42 to 47 degrees C.)

Mention is made of pertinent and related findings of other investigators. The known reflex circulatory responses to various stimuli and the probable mechanisms involved are discussed briefly. Although agreement has not been reached concerning which mechanism produces vasodilatation it is known that capillaries do constrict and dilate when adequately stimulated, with or without involvement of any nervous mechanism.

The report covers 21 studies made on 14 patients, and the observations are recorded in several graphs. Appreciable temperature rises of 0.5 to 2 degrees C. were obtained in all cases except two when a limb was immersed in hot water. It appears that vasodilatation is not dependent on an intact nerve supply, but that greater responses are seen when the nerve supply is present. Tubed pedicles manifest a marked sensitivity to the withdrawal of heat (showing a subsequent temperature fall). This is

a point probably worth bearing in mind in the after-care of pedicles with precarious circulation. The lower ends of both cervical and abdominal tubes show greater responses to remote heat than do the upper ends, and it would appear, therefore, that even abdominal tubes might best be lengthened at their upper rather than at their lower ends.

Ludwig, Frederick E., Lt. (MC) USNR: The Use of Saline Solution, Glycerin, and Acetic Acid in the Care of Burns. *Surgery, 19:* 486, April, 1946.

In an effort to eliminate the foul odor of massive burn dressings left unchanged for periods of one to two weeks Ludwig employed a solution of 15 per cent glycerin and ½ per cent acetic acid in normal saline with the pH about 3.8, which was found to be effective. Dressings in a fresh burn consist of a layer of fine mesh gauze moistened in the solution, 5 or 6 layers of heavy gauze again moistened until they are dripping, and the whole encased as a pressure dressing by Ace bandages. The elastic bandage is removed every 8 hours to remoisten the dressing and then reapplied. The entire dressing is removed for the first time after 9 to 10 days, ¼ gr. of morphine being used for narcosis.

In a series of 358 burns treated by this method, the advantages noted were odorless dressings, with improvement in the patient's morale, absence of maceration of tissues, ease in changing the dressings because of the hygroscopic properties of glycerin, and an adequate check on pyogenic infections from the presence of ½ per cent acetic acid. It is noted, however, that penicillin was administered in every case and occasionally sulfonamides. Under this regime a minimum of grafting has been necessary and epithelization appears to take place more quickly than by other methods.

Editorial Comment: In an uncontrolled series of burns when systemic penicillin is given routinely, we wonder whether any check on pyogenic infection can be ascribed to the presence of ½ per cent acetic acid on the dressings. Likewise, the primary goal in larger areas of third degree burns, especially near joints, should be the earliest possible application of split skin grafts and not the encouragement of spontaneous healing.

Bornemeier, Walter C., and Parsons, Langdon: Treatment of Burns: Report of 155 Cases. *Surg. Gynec. Obst. 82:* 311, Mar. 1946.

Bornemeier and Parsons report on 155 cases of burns, of which 26 were third degree, averaging 20 per cent of the body surface. After the first dressing all burns were dressed or grafted under pentothal anesthesia with two exceptions. In several cases after the removal of eschar they applied the graft directly on fat without waiting for granulation to form. They report a "take" in 90 per cent of the cases and state that in the future this procedure will be their plan of treatment. Several operative procedures were generally required to cover the involved area. They tried a method which, as far as they have been able to determine, has not been advocated before, probably because of the possibility of infection of the donor site. The "accepted technic of placing the grafts in saline solution and later transferring them to the recipient site was abandoned. Instead, they adopted the method of immediate transfer of the skin from the donor to the recipient site. This procedure reduces the time required for the adhesive quality of cut surfaces to cling tenaciously, so that in a matter of minutes it is almost impossible to disturb them and sutures are never necessary. When the donor sites were adequate and the dermatome available it was used. The authors, however, felt that the sections cut with the dermatome did not lend themselves well to direct transfer. The Blair knife or Gillette type of razor blade was used more often, the dermatome being reserved only for coverage of special areas as axillary or popliteal space.

Editorial Comment: Despite the fact that the authors believe "skin grafting in treatment of burns is not the problem of a plastic surgeon," it might be well for them to familiarize themselves with the literature and practices in the field. Direct transfer has been advocated and employed by many surgeons for years, and the floating of the grafts in saline has been decried by some workers since 1930. Direct transfer of as many as 10 dermatome grafts at one operative procedure is not uncommon in some clinics.

Shaw, D. T., and Payne, R. L.: Repair of Surface Defects of the Upper Extremity. *Ann. Surg. 123:* 705, May, 1946.

Shaw and Payne point out the necessity for considering the upper extremity as a functional unit and with an idea of attaining better end results, proceed with a plan that involves few operative stages and periods of joint immobilization. In the early care of the hand they urge splinting in a position of function, maintenance of mobilization of the unaffected part, elevation, and mild pressure dressing. Early closure by secondary suture, split skin grafts or flaps is the choice of replacement surgery. Foreign bodies, sinuses or sequestra are not necessarily considered contraindications for early and complete closure of wounds, especially with the control of virulent organisms by chemotherapeutic and antibiotic agents. Closure of Z-plasty with extensive undermining, supplemented by splitting the superficial fascia to obtain complete mobilization of the skin, is the method of choice where possible. The skin may be closed under maximum tension successfully if accurate approximation of the dermal layer by buried non-absorbable sutures is used. Clean and complete healing is obtained postoperatively before mobilization is begun. When a contracture has been corrected surgically the part is splinted as near full correction as is consistent with optimal healing. The use of hemostatic pressure and stainless steel wire has contributed to good healing. Z-plasty is mainly useful for release of surface contracture and does not usually supply a satisfactory bed for bone and tendon work. The rotation of a double pedicle flap from the dorsum of the finger serves in repair of amputated fingers and argues for preservation of fingers that are later to be amputated. Free skin grafts are employed in large superficial loss of skin.

NOSE

Blair, V. P., and Byars, L. T.: "Hits, Strikes and Outs" in the Use of Pedicle Flaps for Nasal Restoration or Correction. *Surg. Gynec. Obst. 82:* 367, April, 1946.

Blair and Byars review in detail the underlying factors that make for success or failure in substitution of flaps for loss of nasal tissues. They stress the importance of preoperative study of the defect and the surrounding tissue as the outlook of final repair is closely related to careful planning. The latter should also make provision for adequate patency of nasal passages, which is frequently neglected.

Preparation of a pattern on plaster or a cast is urged.

The suitability, intrinsic to the donor area, is of prime importance in the selection of the flap. Flaps taken from above the mandible are characterized by good quality, and those from below the clavicle have the advantage of greater availability. In flaps from the neck these two factors merge.

The supraclavicular flaps can, as a rule, be safely transferred after two preliminary delays. The infraclavicular flaps from the arm or body should be raised in at least three stages.

It is essential not to separate the pedicle at the distal end until the flap acquires adequate circulation as proved by the pressure test. Provision for possible lengthening of the flap in case of partial loss and sectional tubing of disproportionately long flaps to insure good blood supply is urged.

Flaps should not be transferred under the following circumstances: (1) when edema or induration persists, (2) when the patient is in poor general condition, (3) when there is skin infection, and (4) when the flap shows blebs or deep discoloration.

In repair of donor areas the use of a split graft is the usual procedure. Ultimately the split graft is excised and replaced by full thickness skin. If necessary, pigment is instilled into the derma of the transplanted graft with fine needles. According to the authors, skin taken from below the clavicle in most instances loses all vestige of red coloration, while flaps from the cheeks and forehead as well as from the mastoid area retain or regain their natural bluish shade.

Editorial Comment: This well-presented and profusely illustrated paper contains a wealth of information on the subject of nasal restoration.

Brown, James B. and Cannon, Bradford: Composite Free Grafts of Skin and Cartilage from the Ear. *Surg. Gynec. Obst. 82:* 153, Mar. 1946.

The use of a composite free graft of skin and cartilage from the ear for repair in loss of the nostril is advocated by Brown and Cannon. The advantages of the procedure are suitability of the graft and minimal deformity of the donor site. This type of graft is especially indicated for repair of the border of the nostril. The ear is repaired either by a local flap or by burying the defect under a direct scalp flap. The latter is freed in 3 weeks and the skin area grafted. As the recipient site must have a good blood supply, it is imperative to excise all scar tissue widely. The width of the graft is limited to 1 cm.; its length is not important. The graft is cut to pattern and care is taken not to separate the skin from the cartilage.

Editorial Comment: The use of a composite graft from the auricle for repair of the nostril was described in 1902 by König (*Chirurgie 94:* 515, 1914), who acknowledged failure in about 50 per cent of his cases. The improved technic as described by Brown and Cannon evidently made for the successful "take" of this composite graft.

Kazanjian, V. H.: The Repair of Nasal Defects with Median Forehead Flap; Primary Closure of Forehead Wound. *Surg. Gynec. Obst. 83:* 37, July, 1946.

A method of repair of nasal losses by utilizing a median flap from the forehead is described by Kazanjian. The procedure consists in outlining a vertical flap on the forehead between two parallel incisions ¾ to 1 inch apart, extending from the hair-line to the root of the nose. The defect is closed immediately after transfer by direct approximation of the surrounding skin. Limitations in the use of this flap are governed by a low hair-line, or by poor elasticity of the skin (in the young). Vertical relaxation incisions through the fascia on the posterior surface of the lateral flaps contribute to easier closure of defects.

Larger losses are closed by additional horizontal incisions above each eyebrow, which allow for shifting of the flaps toward the midline. The types of nasal deformities suitable for correction by a median frontal flap are: full-thickness skin losses of the dorsum, defects of the tip, nostrils or columella. Where an inner lining is required, a full-thickness graft is inserted under the flap or the latter is enfolded.

Editorial Comment: The vertical forehead flap has the advantage of proximity to a nasal defect and is therefore indicated when the more concealed areas of the upper forehead can not be made available. Whenever possible, it is preferable to outline a flap in such a way as to place the scar in the natural horizontal fold of the forehead or just below the hair-line, where the scars are concealed.

EYELIDS AND ORBIT

Hughes, W. L.: Reconstruction of the Lids. *Am. J. Ophth. 28:* 1203, Nov. 1945.

Hughes describes the operative management of cases in which replacement of full-thickness loss of part or all of one or both eyelids is required. The basic principle is that nothing replaces lid tissue as well as lid tissue itself.

This article is a review of the author's formerly published method of utilizing tarsus from the opposing lid, with free skin graft when indicated, and eyelash graft.

Hughes gives an additional method for reconstructing a third to one-half loss of the upper eyelid, using a sliding tarsal flap from the same lid, which is temporarily fixed to the opposing lid margin and upon which is placed a free skin graft from the opposite upper lid.

Editorial Comment: The article has too much useful information for a brief review and should be read by any one doing eyelid reconstruction.

DeVos, A. G.: Surgery of the Anophthalmic Orbit. *Am. J. Ophth. 28:* 1346, Dec. 1945.

According to DeVos, the commonest cosmetic blemish remaining after the fitting of an artificial eye is the sinking or retraction of the tissues of the upper part of the upper eyelid. He reviews several theories to explain this defect. He advises one or more of several procedures to correct it after first being certain that the best artificial eye has been obtained. These procedures

include a late implant in Tenon's capsule, a cartilage implant to the floor of the orbit in cases of depressed fracture and dermal graft under the skin of the upper portion of the upper eyelid. For a relaxed lower eyelid with shallow lower fornix DeVos employs Wheeler's operation for spastic entropion utilizing overlapping orbicularis strips to increase the muscle tone, with the addition of a mucous membrane graft when it is indicated.

Cutler, N. L., Lt. Col.: Fascia Lata Transplant for Retrotarsal Atrophy of Upper Lid Following Enucleation. *Am. J. Ophth. 29:* 176, Feb. 1946.

In 134 patients in whom enucleation had been carried out, Cutler reports satisfactory results in restoring the normal contour of the upper eyelid by the use of fascia lata strips in a horizontal tunnel under the orbicularis just below the eyebrow.

EAR

Greeley, Paul W.: Reconstructive Otoplasty; Further Observations; Utilization of Tantalum Mesh Support. *Arch. Surg. 53:* 24, July, 1946.

The reproduction of an auricular cartilage still remains the greatest problem in the reconstruction of a new ear.

Greeley describes unsuccessful results with the Gillies' method of reconstructive otoplasty utilizing maternal ear cartilage. Such transplanted auricular cartilages undergo aseptic necrosis within 6 months to 2 years and are replaced by fibrous tissue. The inevitable scar tissue contracture occurs and the resulting ear becomes a small irregular structure unsatisfactory to the patient and surgeon alike. Peer's method of using diced cartilage chips held in a vitallium ear mold appears to be very promising.

Special emphasis is placed on the preservation of ear cartilage by subcutaneous implantation in the abdomen when one is dealing with a complete avulsion of the external ear.

A new method of reconstructive otoplasty is described in which a tantalum wire model of an auricular cartilage is utilized as a support. This fine mesh wire framework is light, has a minimum of tissue reaction, and permits the development of circulation between the open spaces. Reproductions were made from a model of the normal ear.

One actual case is described by the author in which a tantalum mesh support was used. A 23-year old sailor suffered a total avulsion of the ear and adjacent skin. In the reconstruction the tantalum mold was buried beneath the temporomastoid skin flap and left untouched for 7 months. The skin flap containing the tantalum support was then mobilized, brought forward, and the posterior surface of the new ear and temporomastoid bed covered with a stent graft. The scarred periphery of the ear was supplemented with a small tubed pedicle. The final result is shown more than 2 years after the original surgery, with still no evidence of reaction.

Berson, Morton I.: Plastic Repair for Protruding Ears. *Eye, Ear, Nose and Throat Monthly 24:* 423, Sept. 1945.

Berson determines the proper esthetic position of a protruding ear by markings with 5 per cent brilliant green dye and excises the elliptical section of skin outlined by the dye. A section of cartilage is then excised to break the elastic spring of the cartilage, and the sharp margins of the cartilage are bevelled to prevent unsightly ridges. Folds can be eliminated by widely undermining the skin anterior to the remaining cartilage. This type of auricular reconstruction not only repositions the ear to the normal carrying angle with the head, but in addition has formed an antihelix.

HARELIP AND CLEFT PALATE

Blair, T. L., and Tvrdy, H. J.: Cleft Palate Prosthesis for Infants. *Dent. Items 68:* 335, April, 1946.

A wax impression of the infant's mouth and the space between ridges was made by Blair and Tvrdy. This was processed with a handle and ring in clear acrylic resin and was attached to the nursing bottle. The finished appliance included the mucobuccal fold, tuberosities, hard and soft palates, backward to the vibratory tissue and downward to include the bifid uvula. After a few adjustments stability and retention were achieved. The patient did not regurgitate, breathed freely, was satisfied after feeding, and gained in weight.

Kaufman, I.: Treatise on Harelip and Cleft Palate. *Am. J. Orthodont.* *32:* 47, Jan. 1946.

The author considers the operative treatment of clefts of the lips (cheiloplasty; cheilorrhaphy), the alveolar process, the soft palate (staphylorrhaphy), and the hard palate. Kaufman recommends operation rather than wearing of an obturator and vellum in clefts of the hard palate. It is possible, he states, to close any cleft of the hard palate by Ferguson's, Lagenbeck's or Brophy's operation, or a combination of these operations.

Kaufman, I.: Accidentally Acquired Cleft Palate. *Dent. Survey,* *21:* 2218, Dec. 1945.

Kaufman reports the case of a 50-year old woman who lost her entire palate due to an explosion. Only two molars remained in the upper jaw and the ridge was nearly destroyed; the lower teeth were hopelessly damaged. A vulcanite denture constructed on a cast made from the final modelling compound impression improved her appearance, speech, general health and morale.

Chick, A. O., and Peacock, J. N.: Retention of Denture in Edentulous Cleft Palate Case. *Brit. Dent. J.* *80:* 163, Mar. 1946.

Chick and Peacock report the case of a woman, aged 24, with a cleft involving the soft palate and the posterior two-thirds of the hard palate. Two unsuccessful operations in childhood had resulted in scarring and contraction of the halves. The patient had been rendered edentulous. A nasal element of acrylic resin was made, followed by a palatal extension of acrylic resin fitted by an internally threaded tube. An acrylic resin denture was made over the nasal element with the palatal extension. There was a screw in the acrylic denture to engage the threaded tube in the nasal element, and wire loops were attached distally, upon which a solid "bung" type obturator, also made in acrylic resin, was fastened. Vocal resonance improved; no ulceration of the nasal mucosa or absorption of edges of the cleft occurred.

JAW AND FACE BONES

Waldron, Carl W., Peterson, Ralph G., and Waldron, Charles A.: Surgical Treatment of Mandibular Prognathism. *J. Oral Surg.* *4:* 61, Jan. 1946.

In the opinion of Waldron *et alii* the surgical treatment of mandibular prognathism, once a relatively rare operation, has become a commonplace procedure. The seriousness of the operative intervention for correction of prognathism warrants careful preoperative study and the use of a technic that is free from complications and that will ensure a high percentage of permanent correction. The authors believe that an open view operation is essential in order that the predetermined distance of the setback of the jaw may be obtained without displacement of the upper coronoid condyle fragment.

Parker, Douglas B.: Observations on the Definitive Treatment of Maxillofacial Injuries. *J. Oral Surg.* *3:* 320, Oct. 1945.

Parker believes that trained plastic surgeons have made great advances in surgical repair of the skin surfaces of the face. The Z-plastic operation has elongated many contracting approximation scars and has broken up the lines of scar and made the skin more flexible. Many large defects of the face can be corrected by skin or rotating flaps advancing by successive stages. Skin from the neck can be advanced upward several inches over a period of time to close or cover defects. This is a great advantage because such skin rarely becomes pigmented, having the color and consistency of other facial skin. Tube pedicle flaps from the chest or abdomen do not have a good color for the face and should be avoided when it is possible. A tube pedicle flap employing skin from the back of the neck has appeared to have an acceptable color for use on the face. All skin flaps which communicate with the mouth or nostrils must be lined by epithelium, either by doubling the flap on itself or skin grafting a lining to the flap before transposing it into position. Skin losses or contractions about the eyelids can be obtained from the other eyelids, from behind the ear or from the supraclavicular region.

Brown, James B., and Peterson, L. W.: Ankylosis and Trismus Resulting from War Wounds Involving the Coronoid Region of the Mandible: Report of Three Cases. *J. Oral Surg.* *4:* 258, July, 1946.

Brown and Peterson state that inability to open the mouth can be caused by fibrous or bony ankylosis in the region of the jaw joint or by fibrous adhesions following injury to the soft tissues and muscles attached to the mandible. Patients with trismus resulting from scarring may be benefited by Z-plasty or other local shift of flaps. Many of these patients can be aided by dilating the mouth under general anesthesia, incising the scar transversely and blocking the mouth in open position for a period of about 3 weeks. This allows the tissue to heal with the mandible in open position. The operative treatment for both fibrous and bony ankylosis involving the coronoid process is the removal of this process and adjacent involved bone. In treating ankylosis of the temporomandibular joint many operators advocate placing a fascia or muscle flap over the severed bone ends, but this procedure is not necessary if sufficient bone is removed. The crux of the entire operative procedure is the removal of a sufficiently wide section of bone and thorough débridement of the wound before tissue closure.

Brown and Peterson advocate an intraoral approach to avoid involvement of the facial nerve and parotid gland structures. Postoperative exercises of the jaw are of paramount importance in gaining normal function.

Shea, John J.: Management of Fractures into the Nasal Sinuses. *Laryngoscope* *56:* 22, Jan. 1946.

The view is held by Shea that the maxillary sinus is most frequently involved in complicated facial injuries. In the case of coexistent intracranial injury the treatment is expectant and infection must be combated with chemotherapy. If an intracranial lesion can be excluded, surgical intervention is indicated and should be performed by the simplest possible procedure. Under local anesthesia an incision is made as for a Caldwell-Luc operation, to expose the anterior antrum wall. The zygomatic arch, if depressed, can be elevated by three successive manipulations. At first the malar bone is displaced forward, then the arch is sprung outward by adjusting the instrument under the center of the arch, and finally the coronoid process is cleared. If the roof of the antrum is depressed, the antrum is tightly packed with gauze, after which a Ferris Smith antral balloon is inserted and inflated.

Cashman, Charles J.: Delayed Union of Mandibular Fractures. *J. Oral Surg.* *4:* 166, April, 1946.

According to Cashman, delayed union is a relative term. Mandibular fractures vary in many respects, are complicated in many ways, and the period of time required for clinical union will vary with the severity of the associated complications. Mandibular fractures in which no severe complications are present will usually develop clinical union within 4 to 6 weeks following injury. Those with severe complications may require a year or more for clinical union to develp.

Delayed union of mandibular fractures having no severe complications may be avoided in most instances by rational treatment and the elimination of those factors which may interfere with normal bone repair. The most ideal conditions for normal bone repair are assured by close apposition of the fractured ends, early and absolute fixation continued until clinical union has occurred, the elimination of local infection, and a proper diet which includes an adequate amount of vitamins C and D.

Blocker, T. G., Col. M.C., and Weiss, L. R., Capt. D.C.: Use of Cancellous Bone in the Repair of Defects about the Jaws. *Ann. Surg.* *123:* 622, April, 1946.

Blocker and Weiss emphasize that the treatment of bony defects of the jaw must be planned on a long-time basis of preparation for grafting by elimination of infection, removal of sequestra and broken fragments of teeth, and by remedy of soft tissue defects before bone surgery can be attempted. Patience and time are the most valuable adjuncts to reconstructive surgery.

With the use of cancellous bone grafts

from the ilium, the authors have obtained successful "take" in 52 cases, 43 to the mandible and 9 to the maxilla, and they feel that this type of graft is superior to other kinds of bone in repair of large and small defects of the mandible. The selection of a graft or the modification of technic is perhaps, in the final analysis, largely a matter of individual choice, and other workers may be able to show equal success with other procedures.

BENIGN AND MALIGNANT SKIN LESIONS

Maun, Mark E., and Dunning, W. F.: Is the Biopsy of the Neoplasms Dangerous? *Surg. Gynec. Obst. 82:* 567, May, 1946.

On the basis of animal experimentation Maun and Dunning doubt that biopsy of a tumor increases the danger of metastasis. Reluctance to obtain a biopsy specimen for histologic study often delays adequate therapy and invalidates an accurate diagnosis.

It is noteworthy from the authors' experiments that if one removes a portion of a tumor, one increases the length of life of the animal; this increased survival is due presumably to the decrease in the quantity of cells available for growth. These data confirm recent clinical observations that the surgical removal of all available tumor tissue in a seemingly hopeless case serves to prolong the individual's life for several years. Further, no untoward effects are recorded by cutting into the tumor mass or by severing lymphatic channels.

Brandes, W. W., White, W. C., and Sutton, J. B.: Accidental Transplantation of Cancer in the Operating Room. *Surg. Gynec. Obst. 82:* 212, Feb. 1946.

Brandes *et alii* report a case in which several months after a radical mastectomy for a highly malignant scirrhous carcinoma of the breast, cancer nodules were found in the skin of the donor site on the opposite thigh. The usual precautions had been taken after biopsy of the tumor and before the mastectomy, viz., changing of operators' and nurses' gloves, and redraping and repreparation of the patient. However, after the mastectomy, when a defect in the skin over the operative site was to be covered, a skin graft was taken from the left anterior thigh without first changing the contaminated gloves used at operation. Washing the gloves in sterile distilled water was apparently insufficient, and tumor cells were transferred from the operative site to the raw donor area, where they survived and gave rise to tumor nodules.

Previous work in which tumor cells have been demonstrated on knives used for biopsies is reviewed, and it is also shown that the fluid customarily used in the operating room to wash the gloves of the operators is another potential source of contamination of distant parts with malignant tissue.

Glatt, M. A.: Xanthoma or Lipoid Granuloma of the Temporal Bone (Hans-Christian-Schüller Syndrome). *Arch. Otolaryng. 43:* 110, Feb. 1946.

Glatt presents a case of xanthoma of the temporal bone and in an excellent review of the literature stresses the relationship of the condition to the Hans-Christian-Schüller disease. Xanthoma of the eyelids appearing as raised yellow patches is the most commonly seen manifestation of the condition, which may also affect other skin surfaces, the skull, paranasal sinuses, tendons or internal organs. Xanthoma is believed to be caused by a hyperplastic reaction of the reticulo-endothelial cells, which take on lipoids and appear as the characteristic "foam cells" in microscopic sections.

MISCELLANEA

Gross, Robert E., and Scott, H. William, Jr.: Correction of Esophageal Atresia and Tracheoesophageal Fistula by Closure of Fistula and Oblique Anastomosis of Esophageal Segments. *Surg. Gynec. Obst. 82:* 518, May, 1946.

Prior to 1939, as pointed out by Gross and Scott, no therapeutic success in correcting esophageal atresia and tracheoesophageal fistula had been obtained by surgical treatment. A brief review of the previously successful methods of closure of the esophageal ends is presented.

The surgical technic is described in detail in one case in which the patient was success-

fully operated upon by closure of the fistula and oblique anastomosis of the esophageal segments. Surgical correction was done through a right extrapleural mediastinotomy. The upper segment was mobilized to the base of the larynx and the lower segment freed to the diaphragm. The anastomosis was established in oblique fashion in the hope of diminishing the possibility of a postoperative stricture. Gastrostomy was done on the eighth postoperative day but the wound was allowed to close on the seventeenth day. The child was hospitalized only 19 days. Deglutition was satisfactory for the first year of life. Three dilatations were necessary in the thirteenth, fourteenth and fifteenth months.

Romansky, M. J., and Rittman, G. E.: Penicillin Blood Levels for 24 Hours following a Single Intramuscular Injection of Calcium Penicillin in Beeswax and Peanut Oil. *New England J. M.* *233:* 577, Nov. 15, 1945.

According to Romansky and Rittman, a single injection of 300,000 Oxford units of calcium penicillin in 4.8 per cent beeswax (by weight) in peanut oil contained in 1 c.c. produces and maintains effective levels of penicillin in the blood for about 24 hours, and continues to be excreted in the urine for approximately 3 days.

Calcium penicillin in beeswax and peanut oil maintains its potency for at least 9 months at refrigerator and room temperatures up to 37 degrees C. In addition, there is no deterioration after 24 hours at 56 degrees C. or after 2 hours at 100 degrees C.

Editorial Comment: One wonders concerning the reaction of human tissues to beeswax.

Blodgett, James B., and Beattie, Edward J.: Early Postoperative Rising. *Surg. Gynec. Obst. 82:* 485, April, 1946.

A controlled preliminary study of early postoperative rising and walking was made by Bladgett and Beattie on patients who had had major intra-abdominal surgery performed. A total of 681 cases were analyzed for postoperative complications and their causative factors. Early rising is defined as rising and walking on the first or second postoperative day.

The patients who rose early were considerably stronger and had less pain in their wounds. They were able to care for themselves on about the fourth postoperative day and were ready for discharge considerably earlier than the control group.

The incidence of wound disruption and wound infection was reduced in the early rising group.

The incidence of pulmonary complications was somewhat lower in the early rising group.

The incidence of deep leg vein thrombophlebitis was observed to be somewhat greater in the early rising group.

Morani, Alma D.: Evolution of Plastic Surgery. *M. Woman's J. 53:* 25, Jan. 1946.

Morani divides the evolution of plastic surgery into three parts: (1) ancient times, (2) the Middle Ages, and (3) the present.

There are records of plastic operations in ancient times dating back to 2250 B.C. and many more since Sushruta, the father of Hindu surgery, reported the first rhinoplasty. Early Egyptian writings reveal no plastic procedures, but Celsus (30 A.D.) described many of them in his work "De Re Medica." There are recordings of additional plastic procedures by Galen (131 A.D.), Aribasus (325–403 A.D.) and Paul of Aegena (625–690 A.D.). Then medical knowledge declined with the coming of the Goths and Visigoths.

In the Middle Ages a slow return to the reporting of plastic procedures is noted. In the fifteenth century the famous surgeons of the Branca family did many plastic operations and developed the Italian method of rhinoplasty. Caspar Tagliacozzi (1546-1599) in 1597 published his famous treatise "De Curtorum Chirurgia per Institionum." There followed a dearth of literature on plastic procedures until the time of von Graefe, who, in 1818, published his work entitled "Rhinoplastics." Then such notables as Dieffenbach, Lisfranc, Warren, Mittauer and Pancoast made valuable contributions. Ollier (1861), Wolfe (1875), Thiersch (1886) and Krause (1893) laid the foundation for modern free skin grafts.

In the section on progress of the present

day the author speaks of the strides made during World War I and II. Among others she mentions the contributions of such men as Blair, Davis, Gillies, and Ferris Smith, who have largely formed our present conception of plastic surgery.

Penn, Jack: Plastic Surgery in the U. S.A. *South African M. J. 20:* 666, Nov. 9, 1946.

Penn, who is professor of Plastic Surgery at the University of Witwatersrand, South Africa, writes about his impressions of plastic surgery in the United States. He visited many clinics and noted the widespread use of the Padgett dermatome for skin grafting but expressed surprise that very few clinics utilized the coagulum contact method in skin grafting. Other procedures mentioned are the management of scalp wound, eyebrow reconstruction, ear and eyelid repairs and rhinoplasty. Penn was very favorably impressed by the high standard of training required by the American Board of Plastic Surgery for all men desiring to qualify in this field of medicine.

MANDIBULAR RECONSTRUCTION IN JAW DEFORMITIES*

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AND

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The material in this paper has been gathered from experience in the handling of three hundred and eighty-seven Maxillo-Facial patients over a period of one year. Since the major problem in these jaw deformities lay in reconstruction of bony continuity and the related soft tissue bed, information here set forth groups itself about this phase. Out of the three hundred and eighty-seven patients, sixty-four showed malunion or non-union with loss of substance. Thirty-four of these ultimately required large bone graft replacements. Twenty-seven were completed during the period. The plan of procedure, illustrations of methods, and results, with reference to special complicated types of deformity are reported.

Survival of the war wounded with lower face injuries far exceeded the previous war's record. Their initial treatment and care came from the Army's carefully trained aide men and the well qualified surgeons at front line posts. Tribute should be paid these men. As a result of early surgical care, definitive repair was greatly facilitated. This was largely brought about by the preservation of soft tissue and bony architecture.

Jaw reconstruction is a compound problem whose solution in the definitive stage is initiated by mandibular fragment control and soft tissue bed reconstruction. With this established, bone grafting, if necessary, can be accomplished. The third problem to be met concerns ridge extension or sulcus formation. This becomes necessary to provide a recipient area which will permit the carriage of dental prosthesis. The final step consists of soft tissue revision for general appearance.

Early and intermediate care out of the way and the patient's condition in normal balance, the problems presented in bone transplantation lie first in the preparation of the recipient field. This begins with dental care. Temporary splints are constructed to maintain fragment alignment while infection of dental origin is cleared up. At this time oral hygiene, incision and drainage, sequestrectomy, and removal of nonviable teeth and tooth fragments is carried out.

After healing has been achieved, soft tissue losses are replaced. This is accomplished by a variety of plastic means, depending on the nature of the deformity present. Tissue revisions vary from excision and closure of entrance and exit wounds to complete reconstruction of the jaw soft tissue. In this series, local

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revision was adequate in all but four cases. In the former, rotation flaps and collar shifts with free graft to the donor site sufficed. In the latter, tube pedicle soft tissue transplants were utilized.

1-A

1-B

1-C

Fig. 1-A. Demonstrates the use of Continuous Posterior Traction to Angle Fragment of the Mandible by Means of a Parallel Side Arm Bar

This patient had a loss of body continuity. The posterior fragment was hyperoccluded and lingually deviated.

Fig. 1-B. Demonstrates the use of an Acrylic Saddle to Maintain the Repositioned Posterior Fragment while the Bone Transplant is in Place

Fig. 1-C. Demonstrates the Cap Metal Glide Splint Used in Preliminary Positioning of Bony Fragments into Proper Occlusal Relationships for Subsequent Bone Grafting

METHOD OF FRAGMENT STABILIZATION

Mobilization and splint fixation of the jaw bone provides no difficulties when a good component of teeth is present. It is the edentulous area with associated lingual labial and hyperoccluded fixations that tax the ingenuity. Combinations of several procedures have been found useful. Intra-oral rubber band traction has proved its value and place coupled with modified orthodonic principles. Extra-oral traction continued by support from a head cast or parallel posterior

2-A 2-B 2-C 2 D 2-E 2-F

FIG. 2-A. H. E. 1ST LT., AGE 34 SUSTAINED AN ASSAULT INJURY RESULTING IN A COMPOUND FRACTURE AT THE ANGLE OF THE LEFT MANDIBLE WITH SUBSEQUENT OSTEOMYELITIS

This X-ray demonstrates the healed condition presented. There was malunion with hyperocclusion and lingual deviation.

FIG. 2-B. ROENTGENOGRAM DEMONSTRATES STABILIZATION OF THE POSTERIOR FRAGMENT BY THE MECHANICS OF THE GRAFT ALONE

At operation marked eburnation was found requiring extensive decortication to reach good bleeding bone.

FIG. 2-C. DEMONSTRATES THE EARLY APPEARANCE. SPLINTING WAS EFFECTED BY INTERMAXILLARY ELASTIC TRACTION AND CONTINUOUS LOOP WIRING

FIG. 2-D. ROENTGENOGRAM SHOWS THE BONE GRAFT IN PLACE COMPLETING THE CONTINUITY OF THE MANDIBLE

FIG. 2-E. RECONSTRUCTED MODEL SHOWING BAR TYPE OF SILVER SPLINT WITH LOCK BAR

FIG 2-F. SHOWS ONLAY OVERLAP BONE GRAFT WIRED IN PLACE—ANTERIOR VIEW

side bar attached to an intra-oral splint (fig. 1) has been useful. The new position is maintained by intra-oral splinting combined with an acrylic or silver saddle. No untoward ulcerations, or necrosis of the alveolus from saddle pressure tend to occur if they have been constructed with broad surfaces and rolled edges.

3-A 3-B

3-C 3-D

FIG. 3-A. D. M. CPL. AGE 23

Sustained a shell fragment wound of mandible, 1 April 1945 resulting in complete destruction of the symphysis. Preliminary treatment consisted of continuous maxillary loop wiring with elastic traction.

FIG. 3-B. ROENTGENOGRAM AFTER BONE GRAFT—CONTINUOUS LOCK BAR CAP METAL SPLINTS WERE EMPLOYED FOR FIXATION

FIG. 3-C. RECONSTRUCTION MODEL SHOWING COMBINATION CAP AND SILVER BAR SPLINT FIXATION

FIG. 3-D. ONLAY CREST GRAFT COMPLETES THE CONTINUITY LOSS. IT IS WIRED IN PLACE

The saddle splint has been used in those cases where one mandibular side has teeth and there is an associated posterior edentulous angle fragment. A flange glider splint (fig. 1-C) in the initial stages pulls the tooth fragments into occlusion where they are finally fixed by lockbar cap metal splint. The edentulous segment mobilized by external traction is maintained in position by the intra-oral

Fig. 4-A. M. A. Sgt.

Age 24 was wounded by shell fragments 9 January 1945. He sustained a loss of all maxillary teeth, and destruction of mandibular continuity from the ramus to the symphsis. The posterior fragment was hyperoccluded. It was brought down into place by external traction. The position was maintained by an interoral saddle fixed by means of a cap metal splint to the remaining mandibular teeth.

Fig. 4-B. The Lateral View Shows the Onlay Bone Graft in Position

The mandibular splint has been locked to an acrylic maxillary denture. This latter has been fixed by Strut wires, passing through the cheeks to external metal arm bars incorporated in plaster head cast.

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3-A 3-B

3-C 3-D

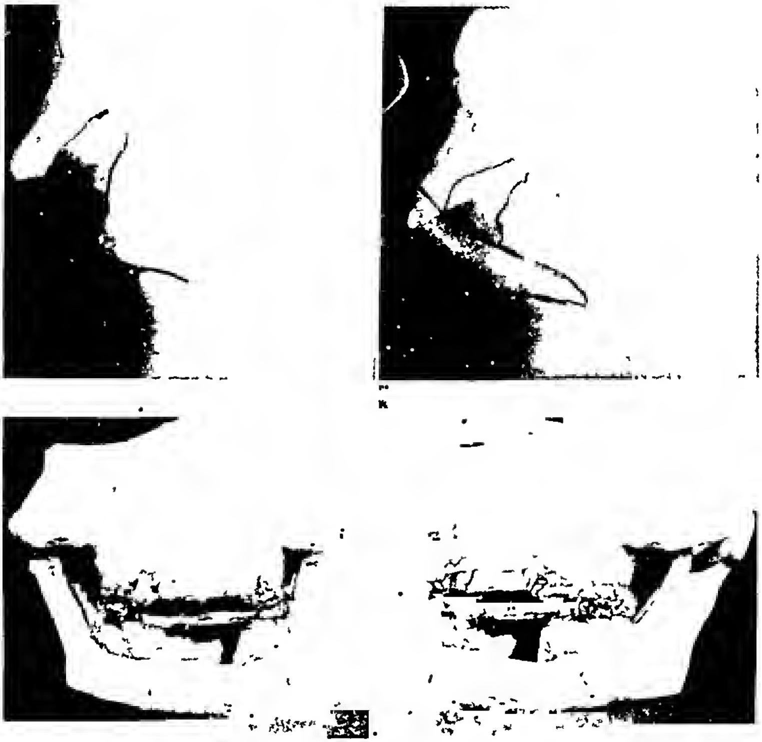

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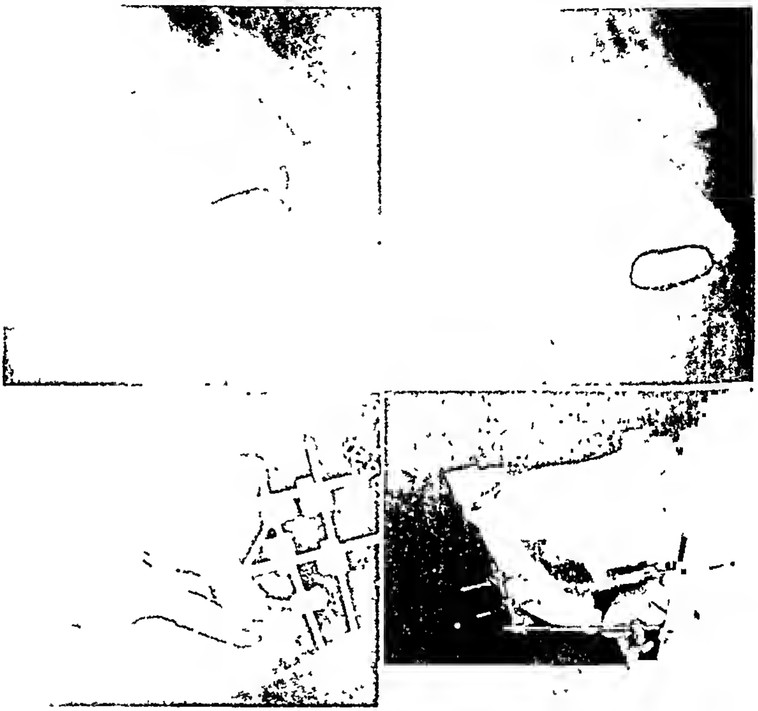
FIG. 4-B. THE LATERAL VIEW SHOWS THE ONLAY BONE GRAFT IN POSITION

The mandibular splint has been locked to an acrylic maxillary denture. This latter has been fixed by Strut wires, passing through the cheeks to external metal arm bars incorporated in plaster head cast.

saddle block. The procedure coupled with careful wiring of the bone graft has been more satisfactory than grafting and attempting to maintain posterior fragment position by external traction. This latter is usually associated with wobbling of the graft joint, and concomitant non-union. In those cases where the anterior symphysis area lcss and edentulous lateral body, with its mesial

5-A 5-B



5-C 5-D

FIG. 5-A. W. B. PVT. AGE 38

On admission to the hospital presented an edentulous mandible showing mal-union. The posterior fragment was hyperoccluded and lingually deviated.

FIG. 5-B. DEMONSTRATES THE FINAL RESULT AFTER OSTEOTOMY AND BONE GRAFT

FIG. 5-C. DEMONSTRATES THE METHOD OF FIXATION USING THE ROGER ANDERSON SPLINTS

At operation,the bony union was broken up. The fragments were re-positioned and a small onlay cancellous bone graft was used to improve continuity.

FIG. 5-D. RECONSTRUCTED MODEL

The mandibular pin compound was fixed to the maxillary teeth to insure stability.

swing giving the bird face deformity, have required osteotomy and circumferential wire traction to restore primary arch position, the flange saddle has been valuable also in maintaining fragment position. With the problem of the edentulous maxilla and continuity loss in the body of the mandible with edentulous posterior fragment (fig. 4), control sufficient for a successful grafting can be had by a combination of intra and extra-oral fixation. A cap metal splint and

posterior saddle is constructed for the mandible. A properly fitting denture for the edentulous maxilla is made and held in place by strut wires passed through the cheek to metal armatures incorporated in a plaster head cast. When both mandible and Maxilla are treated in this manner the jaws can be locked together. Stabilization is then sufficient for good results. When the lower jaw is completely edentulous and a few teeth remain in the maxilla (fig. 5) combined intra and extra-oral fixation can again be utilized. Here external splinting is used for the mandible. The fragment position is maintained by Roger-Anderson pins. A bar splint attached to the remaining maxillary teeth allows the upper jaw to be locked, by bar armature, to the Roger-Anderson compound. The arrangement has seemed to improve stability. With both maxilla and mandible edentulous, combinations of these two methods may be considered.

Ordinarily, if external traction does not mobilize and reposition the fragment in two or three weeks, surgery is indicated to free the adherent area. In some of the cases, immediate bone graft without decortication may be employed. The position is maintained by firm graft wiring alone. Considerable care in wiring the ramus fragment is imperative to prevent disturbance of graft attachment by tissue motion during the swallowing process.

ANESTHESIA AND OPERATIVE PROCEDURES

Bone grafting of the jaws can be accomplished with either Procaine block or intra-tracheal inhalation anesthesia. Intravenous anesthesia should not be used. It is fraught with considerable danger when employed in operations about the mouth and throat because of associated laryngospasm and asphyxia. When two operating teams are utilized, nerve block and spinal anesthesia are adequate. Here one group of surgeons removes the graft while the other group prepares and places the transplant in the recipient area. Where one surgeon must do both operations, intra-tracheal anesthesia might be the choice on the basis of time allowance, if the defect is of magnitude.

It is well to expose the jaw fragments, mobilize them, and determine the area of eburnated bone ends that will have to be removed before the graft is cut. Not infrequently, one will find that the quantity of bone required is greater than the length estimated. This is especially true where intermediate attached fragments have been allowed to remain in the jaw continuity. These, even though they attach to one or the other fragment ends, may not be sufficiently vascularized throughout to insure graft take and may at operation, have to be largely removed. If one has already cut his transplant and after rongeuring away eburnated bone, finds the graft of insufficient length, the interval may be spanned by splitting the transplant and wiring its mid section in over lap fashion. In such a case it is well also to pack bone chips without cortex beneath the graft continuity.

At the time of actual transplant the graft bed should be freed of all fibrous tissue. Recipient sites so treated allow the supple tissues to fall into closer approximation to the bone graft. Serum and blood accumulations are eliminated and a more rapid vascularization of the transplant takes place.

The ideal to be achieved, given a balanced general metabolism, is an adequate bone graft situated in a good soft tissue bed with an efficient minute circulation.

In such a situation if proper fixation is continued for a sufficient length of time mandibular continuity should be re-established.

Regarding the donor site, incision is made over the crest border, extending from the anterior superior spine posteriorly for about two-thirds of the crest range. Retracting the soft tissue and muscle exposes the periosteum. Incision and elevation here should be carefully done in a manner so that no shredding of the periosteum may occur. Should this take place, not only is closure more difficult, but periosteal ribbons and shreds fanning outward may give rise to subsequent formation of crest spurs. These may be an inch or greater in length. These exostosis are usually of no special clinical significance unless the patient discovers their presence. Care should be used in removing the cancellous bone to avoid seeding the adjacent soft tissue. If this occurs, however, time may see the disappearance of these bone cell deposits. Inadequate approximation of soft tissue and control of hemorrhage in the donor site should not be permitted because of the associated complication of hematoma and post-operative infarct.

POST OPERATIVE SPLINT FIXATION

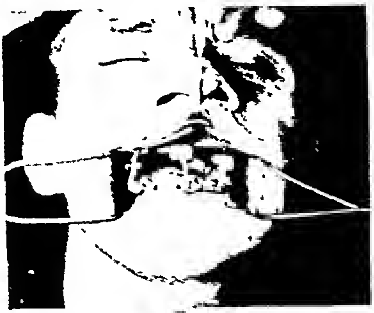
The duration of post-operative splint fixation varies with the magnitude and location of the grafted defect. Fixation for eight weeks is usually sufficient for a small transplant. Twelve weeks or longer may be necessary with cautious removal where larger segments are required. Where the graft is long, and situated between fragment ends with teeth, and fixation has been removed too soon, fracture of the transplant in the mid area may occur. This is followed by fibrous union and variable degrees of eburnation of graft ends. Where the transplant extends from the "R" or "L", 11, area to the ramus, without proper application of fixation, defect in continuity may also occur. The mechanical force at the ramus ends tends to be of a bending nature. At the anterior attachment it is a shearing force. Insufficient maintenance of jaw fixation here may be associated with graft solution and fibrous fusion at its anterior extremity posterior to the graft joint. Repair can be brought about by excising the fibrous adhesions and surfacing rongeuring of the graft and adherent graft overlap. Bleeding is profuse and no length segment may need to be removed. Packing with bone chips establishes firm continuity. Graft fracture following decalcification may occur also when the saddle is used. If this fixation method has been applied with force, in the absence of free easy fragment mobility, when the restraint is removed the resilient fibrosis impels the return of the deformity. This persistent tendency may effect a strain on the graft continuity resulting in fracture or a non-union.

It can not be too greatly emphasized that, after splint removal, examination for evidence of clinical mobility be carried out repeatedly. If this is carefully done, watching in anticipation, areas of functional stress or strain alterations in continuity can be caught at inception. Splint maintenance may be required up to six months. Interval unlocking being permissible only after twelve weeks.

DEFINITIVE SOFT TISSUE REPAIR

Ridge extensions or restorations of sulci (fig. 9) are the third step in the reconstruction program. Sufficient intra-oral tissue loss may be present to require skin grafting. Dermatome grafts are used, applied with onlay technique.

6-A



6-B

6-C

FIG. 6-A. J. D. SGT.

Age 26 sustained a compound comminuted fracture of the maxilla and mandible. This was a result of shell fragment wounds received 10 November 1944. There was a loss of mandibular continuity from the proximal one-third of the ramus to the anterior body. Preliminary definitive treatment consisted of external traction applied to both the posterior and anterior fragments associated with excision of cicatricial tissue. A glide metal splint could not be used here because of the edentulous maxillary area. Intra-oral method of splint fixation utilizing the molar maxillary area on the left. Stabilization on the right was enhanced by an inverted acrylic maxillary saddle.

FIG. 6-B. ROENTGENOGRAM SHOWS THE PREOPERATIVE APPEARANCE WITH CONTINUITY DEFECT ON THE LEFT

FIG. 6-C. ROENTGENOGRAM SHOWING THE BONE GRAFT IN PLACE

The posterior fragment was wired to the ramus. The graft was only partially decorticated. The anterior superior iliac spine was removed as part of the graft and inverted in position.

Intra-oral splints with attached silver baskets can be constructed. Dental compound fitted to the deformity contour is molded about the basket. Skin grafts are adhered to the stent with rubber cement and sutured in place. Considerable over-correction should always be allowed. Ordinarily at operation a double model stent is made. One is left in situ the other taken to the laboratory

7-A

7-B

7-C

7-D

7-E

FIG. 7-A. RECONSTRUCTED MODEL SHOWING BONE GRAFT REPLACEMENT OF THE RAMUS AND BODY

FIG. 7-B. DEMONSTRATES CAP METAL SPLINTS WITH GLIDER LOCK AT THE LEFT

FIG. 7-C. MODEL ILLUSTRATING SOURCE OF BONE GRAFT MATERIAL AND THE UTILIZATION OF THE SPINE AREAS

FIG. 7-D. ROENTGENOGRAM SHOWING THE AREA OF BONY LOSS

This soldier age 24 sustained a G.S.W. of the left mandible, 21 February 1945 resulting in a shattering of the ramus and body.

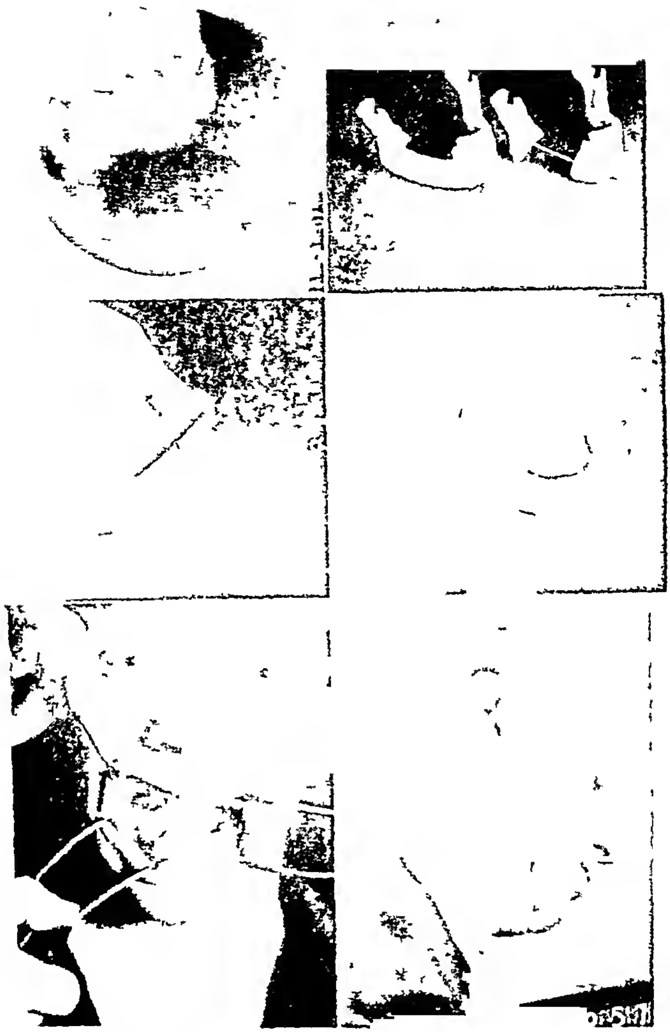
FIG. 7-E. THIS X-RAY SHOWS THE GRAFT TRANSPLANT IN PLACE

It was fixed at the distal end. At the condyle neck firm fiberous union has occurred. With jaw extension condyle head excursion can be palpated through the external auditory canal.

to have a duplicate model formed in acrylic. This post-operative stent is worn in place to assist in overcoming graft contraction.

8 A

8-B



8 C

8 D

8 E

8 F

Fig 8 A K S Pvt

Age 24 presented on admission a complex compound odontoma which had destroyed the continuity of the mandible There was an associated intra and extra oral perforation with drainage

Fig 8 B Reconstructed Model Showing Area of Resection and Onlay Overlap Bone Graft in Position Replacing the Body Loss

Fig 8 C Roentgenogram after Removal of the Tumor Mass

A Steinman pin has been passed from the symphysis into the posterior fragment to maintain position

Fig 8 D Roentgenogram Shows the Bone Graft Completing Mandibular Continuity The Transplant was Taken from the Iliac Crest

Fig 8 E Bar Metal Splints were used to Lock the Jaws Together The Area to the Left Shows the Resected Interval

Fig 8 F Demonstrates the Incision Area of Approach

7-A

7-B

7-C

7-D

7-E

FIG. 7-A. RECONSTRUCTED MODEL SHOWING BONE GRAFT REPLACEMENT OF THE RAMUS AND BODY

FIG. 7-B. DEMONSTRATES CAP METAL SPLINTS WITH GILMER LOCK AT THE LEFT

FIG. 7-C. MODEL ILLUSTRATING SOURCE OF BONE GRAFT MATERIAL AND THE UTILIZATION OF THE SPINE AREAS

FIG. 7-D. ROENTGENOGRAM SHOWING THE AREA OF BONY LOSS

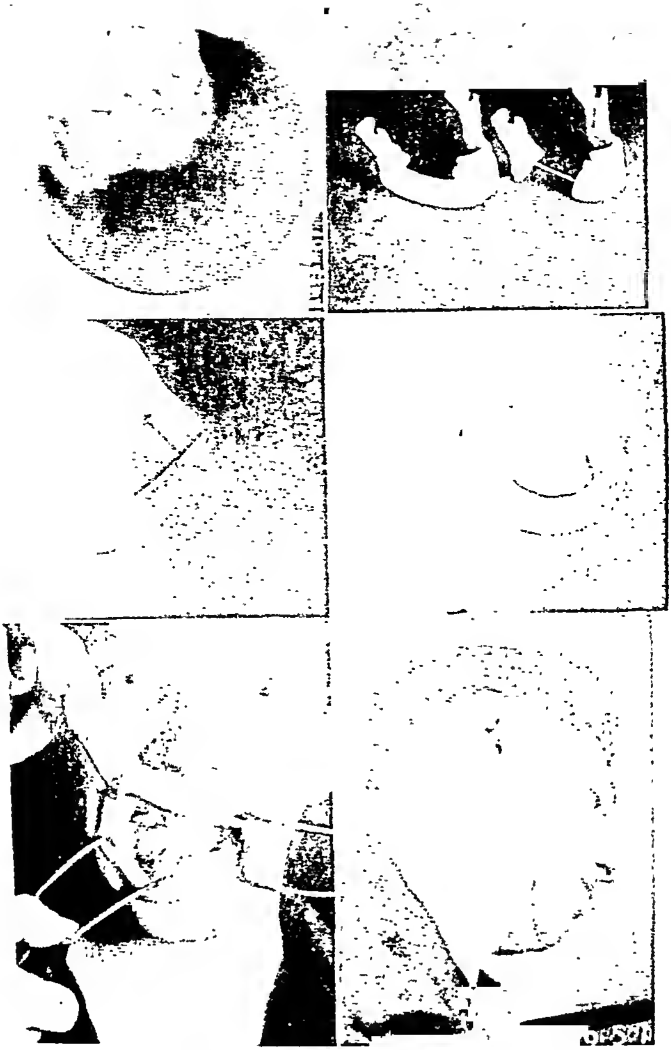
This soldier age 21 sustained a G S.W. of the left mandible, 21 February 1945 resulting in a shattering of the ramus and body.

FIG. 7-E. THIS X-RAY SHOWS THE GRAFT TRANSPLANT IN PLACE

It was fixed at the distal end. At the condyle neck firm fiberous union has occurred. With jaw extension condyle head excursion can be palpated through the external auditory canal.

to have a duplicate model formed in acrylic. This post-operative stent is worn in place to assist in overcoming graft contraction.

S-A S-B



8 C S-D

S-E S-F

FIG. S-A. K. Š. Pvt.

Age 24 presented on admission a complex compound odontoma which had destroyed the continuity of the mandible. There was an associated intra and extra-oral perforation with drainage.

FIG. S-B. RECONSTRUCTED MODEL SHOWING AREA OF RESECTION AND ONLAY OVERLAP BONE GRAFT IN POSITION REPLACING THE BODY LOSS

FIG. S-C. ROENTGENOGRAM AFTER REMOVAL OF THE TUMOR MASS

A Steinman pin has been passed from the symphysis into the posterior fragment to maintain position.

FIG. S-D. ROENTGENOGRAM SHOWS THE BONE GRAFT COMPLETING MANDIBULAR CONTINUITY. THE TRANSPLANT WAS TAKEN FROM THE ILIAC CREST

FIG. S-E. BAR METAL SPLINTS WERE USED TO LOCK THE JAWS TOGETHER. THE AREA TO THE LEFT SHOWS THE RESECTED INTERVAL

FIG. S-F. DEMONSTRATES THE INCISION AREA OF APPROACH

9-A

9-B

FIG 9-A R K PVT

Age 28 sustained a destruction of the alveolar ridge and fiberous obliteration of the labio-buccal angle. Resurfacing was achieved by using a free skin graft taken from a non-hairy area A dental compound stent molded over a silver basket attached to a bar splint supplied apposition pressure

FIG 9-B A P PVT

Age 21 sustained a complete avulsion of the anterior palate This plate demonstrates the method of closing such a defect by supplying extra-oral tissue This patient also presented a destruction of the mandible which required bone graft.

The fourth stage of reconstruction consists largely of the definitive treatment of the pedicle transplant (fig. 10, 11) required to supply the losses in the soft tissue bed. After the bone graft has restored the arch and sufficient time has elapsed the skin surface of the pedicle, with the exception of massive reconstruction, can be excised leaving the subjacent soft tissue in place. Facial skin can then be mobilized over its summit. If an adjacent segment of lower lip has had

10-A 10-B

FIG. 10-A. C. R. CAPT.

Age 30 presented a deformity of the jaw showing continuity loss of the mandible along with soft tissue bed destruction and avulsion of two-thirds of the lower lip. This plate illustrated the use of the transverse neck tube pedicle for smaller defect replacements. After bone grafting most of the skin surface of these pedicles can be removed. The cheek tissue is mobilized over the replacement. When this can be accomplished the appearance is much better since foreign tissue is seldom of the right color.

FIG. 10-B. J. S. T/SGT.

Age 32 as a result of shell fragment wounds sustained an avulsion of the lower jaw. Only the proximal one-third of the ramus remained. Demonstration here shows the use of the thoraco-abdominal tube pedicle where massive soft tissue replacements are required. The amount of ultimate surface replacement varies depending upon the transplant volume, available adjacent skin surface, and the previous scarring.

to be reconstructed also, a nasolabial flap can be turned down to replace pedicle skin. A mucosal flap from the cheek lining can be utilized for vermillion border.

SURVEY OF CASES

During the period from 17 May 1945 to 1 June 1946, three hundred eighty-seven (387) Maxillo-facial patients were admitted to the Crile General Hospital service. Of these, three hundred forty-three required some operative procedure. One hundred and forty-seven required multiple soft tissue stages. Forty-four required dental care only. Sixty-four (64) showed bone loss. Twenty-five (25) of these had ultimate continuity established by immobilization of fragments

11-A 11-C

11-B 11-D

Fig. 11-A. G. W. Sgt.

Age 33 sustained an avulsion of the lower jaw, floor of the mouth and mandibular continuity from the proximal one-third of the ramus. Here the transverse segment of lower lip remains, in contrast to the complete evulsion in the case of J. S. Fig. 10-B.

Fig. 11-B. Demonstrates the Method of Tube Pedicle Insert which Begins the Reconstruction of the Soft Tissue Bed. This is a Thoraco-abdominal Tube Pedicle

Fig. 11-C. Shows the Side View with Tube in Place

The closed suture side has been opened and grown to the inferior border of the transverse lower lip segment. The posterior border is split and sutured to the soft tissue of the neck.

Fig. 11-D. Front View Demonstrates the Appearance at the Time for Insertion of the Bone Graft. Subsequently the Excess Soft Tissue Can be Excised and Adjacent Cheek and Chin Skin Mobilized to Improve Appearance

only. Five required preliminary osteotomy without bone transplant. In thirty-four (34), long bone grafts were required. Of the three hundred eighty-seven cases, two hundred and thirty-three had previously had fracture of the mandible. Eighty-five had fracture of the maxilla. In fifty cases, both maxilla and mandible were fractured at some time. Fourteen showed fracture of the condyle with fracture of the body. Six showed condyle fracture only. There were twenty fractures of the malar maxillary compound. Sixty-two cases had alveolar ridge destructions. Forty-four showed ridge avulsion with obliteration of the buccal or labial sulcus. There were twenty-eight palate perforations and oral antral fistulae. Secondary trismus of variable degree occurred in one hundred fifty-nine cases. There were four neoplasms in the series. There was one osteoma, one odontoma, one showing changes resembling leontiasis ossea, and one showing metastastis of squamous cell carcinoma from a branchial cyst.

The bone grafts in the series were completely decorticated in twelve instances. Partial decortication was performed in ten cases. In twenty-one cancellous bone chips were employed beneath the continuity of the transplant. All grafts were wired into place with stainless steel wire. Large grafts were required in the majority of instances since obtaining good bleeding bone required rongeuring away of considerable extent of eburnated bone ends. Bone losses varied from one centimeter to major losses extending from the proximal third of one ramus to the proximal third of the corresponding ramus. Four cases required reconstruction of one-half of the mandible. In two, the anterior superior and inferior spines of the ilium (fig. 7) were incorporated in the graft. In only one of these cases was the transplantation done prior to the six months recovery period. This was the case of resected odontoma (fig. 8) showing complete mandibular destruction with intra and extra-oral perforation. In this instance, bone transplantation was performed two months after resection. Intense chemotherapy was utilized. The graft take was successful.

The complications were as follows: in one case, intra-oral perforation occurred at operation. Osteomyelitis followed in spite of chemotherapy, with complete graft loss. One graft failed to unite to the posterior fragment because of joint wobbling, the result of the parallel silver bar method of fixation. Two graft transplants showing demineralization, one at the mid section, the other at the anterior extremity, fractured, permitting jaw mobility. Re-grafting established continuity. There were three cases of post-operative drainage from inadequate soft tissue coverage over the transplant and subsequent soft tissue breakdown. In each, secondary closure with Penicillin was followed by complete recovery. One case showed pulmonary infarct post-operatively. Patient recovered.

SUMMARY

The principles of bone healing seen in primary fracture in general were repeated following bone transplantation. Cancellous bone was used as graft material because of its superior osteogenic properties. Most grafts were partially or completely decorticated to assist a more rapid vascularization. Little or no

decortication was done in ridge grafts employed where some mechanical help in maintaining position of the edentulous fragment was thought helpful.

A balanced general metabolism with an adequate bone graft situated in a good soft tissue bed with an efficient minute circulation, is the ideal to be attained. Given this situation and proper fragment fixation maintained for a sufficient length of time, mandibular continuity becomes permanently established.

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EXPERIENCES IN THE USE OF CELLOPHANE AS AN AID IN TENDON SURGERY[1]

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Among the many unsolved surgical problems is the consistently satisfactory restoration of sliding action of tendons after injury to the mechanism involved. This mechanism includes tendon, tendon sheaths and annular ligaments. The forearm tendons have a wide amplitude of excursion. In the wrist, hand and fingers, where the surrounding tissues are relatively immobile they move by sliding in tunnels which are lined with mucous sheaths. These sheaths are reflected onto the tendons. The reflections carry the blood vessels. At the ends of the tunnels the mucous sheaths turn off the tendons onto the surrounding tissue. At these points, when movement takes place there is considerable invagination of the sheaths into the tunnels except at the insertion of the tendon. Besides the synovial lining of endothelial plates arranged so as to form smooth surfaces, the sheaths are composed of an outer tunic of fibro-elastic bundles. In certain areas they are reinforced by dense fibrous bands, the annular ligaments. These counteract any tendency of the tendons to displacement when the joints are angled.

The tendons whose function is most seriously affected by injury, are the flexors of the fingers and thumb. Furthermore the commonest disabling injury is damage to the sliding mechanism in the area from the proximal transverse palmar crease to the distal digital crease. The ability to flex the interphalangeal joints is lost. The metacarpo-phalangeal joint can usually be flexed fully by the interosseous and lumbrical apparatus. The loss of function is due to the absence of the sliding action between the injured tendon and sheath. Adhesions formed during the healing stage completely eradicate function as this part of the sheath is firmly adherent to the metacarpal and phalangeal bones and in some positions to the annular ligaments.

So many severely crippling lesions of this nature were seen that an attempt was made to restore function by means of interposing a foreign material on which the tendon could glide, and which would prevent adherence of the tendon to its surroundings.

This attempt, which will be described, has given results varying from complete failure to complete success. There were various reasons for the lack of publication of the procedure until the present but the most important is that uniformly successful results neither have been nor are being obtained. Indeed from a survey of cases so treated there were more failures than successes at first. However, as various lessons have been learned, and as interposition substances of a nature other than the autogenous free grafts of various tissues, still may be of

[1] Read before the American Society for Surgery of the Hand—Chicago—January 1947. From Department of Surgery University of Toronto Hospital for Sick Children.

decortication was done in ridge grafts employed where some mechanical help in maintaining position of the edentulous fragment was thought helpful.

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which had been stripped of its mesentery for some distance and surrounded with an interposition substance. The cellophane was then used as a slip interposed between the tendon and the rigid structures on the posterior surface

Since 1936 cellophane has been used occasionally in patients as an aid in tendon surgery. A few cases, all of whom were operated upon many years ago, will be illustrated by a moving picture record. These were chosen to demonstrate difficulties, and good and bad results Only occasionally did the procedure seem indicated. It was considered indicated as a final resort in cases who had had severe initial damage or many previous surgical procedures and where the

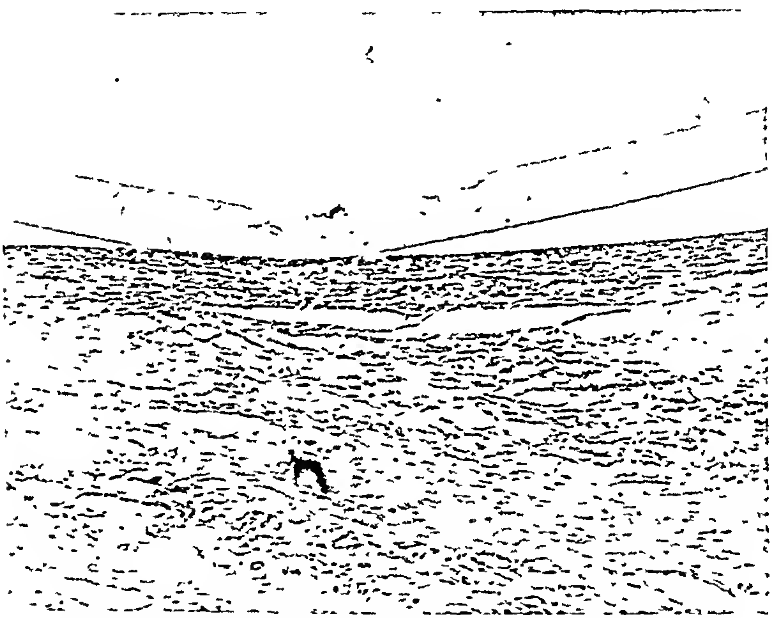

FIG 1 SHOWS THE TISSUE REACTION TO A PIECE OF 450 GRADE CELLOPHANE
This had been placed in a dog's leg and recovered some months later A smooth layer of dense fibrous tissue faces the cellophane

transmission of power from the muscles to the fingers was almost or completely restrained by adhesions. Many of the tendon sheath injuries were associated with damage to bone—carpals, metacarpals or phalanges. The use of paratenon, or the areolar tissue from the external surface of the fascia lata had not given satisfying results and in an attempt to obtain improvement the use of a non-absorbable film was decided upon. The change to a buried foreign body has certain obvious disadvantages. The interposition substance necessarily separates the tendon from its usual source of blood supply through the vinculum Some reaction to the alien material by the neighbouring living tissues is always present In positions where there is constant motion there is a tendency for

value in this type of surgery, the following description of the work performed is presented. It may be of assistance to others contemplating the use of such substances in tendon surgery, and yet dampen any undue enthusiasm for this type of therapy.

In 1932 cellophane was used as an interposition substance between a large delayed skin flap and its bed in order to prevent reattachment of the flap to the deep tissues, and encourage increased blood supply into the base of the pedicle. On elevation of the flap there was found a cavity with smooth moist walls. Histological examination showed a lining of fibrous tissue. Those cells lining the cavity were flattened. There were also many white blood cells in the neighbouring tissues. Macroscopically the cavity looked like a bursa with a small amount of mucoid material in it. At the time the notion that an excessive amount of fibrous tissue had formed in the walls of the cavity did not make much impression. This fact is mentioned because instances have been reported where cellophane films have been used for the express purpose of producing dense fibrous tissue. (1). This incident together with the suggestions of Dr. Dudley Irwin, then of the Department of Medical Research, encouraged animal experimentation on the implantation of cellophane with the object of using it as an interposition substance in tendon surgery.

The study was commenced in 1932 and worked at intermittently until 1940. The experimental work has lately been recommenced in order to find more suitable materials. At first rabbits were used but dogs were later substituted on account of their size. Many troubles were encountered. Careful suture of the tissues in layers over the cellophane was necessary, otherwise a sinus developed between the skin surface and the area of the implant. There was then a continual leak of serous exudate until the cellophane was removed. The cellophane had a tendency to "bunch" instead of remaining flat as a sheet. It was difficult to maintain in one position as it would tear when suture of it was attempted. One method of operation was to expose sheaths and tendons after turning back a skin flap. The sheaths and annular ligaments were incised and the tendons and sheaths were traumatized by nicking and scraping with a scalpel. The cellophane was placed around single tendons or tendon groups and held in place by ligature which surrounded the cellophane and tendon. The operative areas were reopened at various intervals and viewed macroscopically and microscopically. Macroscopically the surface of the tendons again became smooth. A smooth walled cavity surrounded the cellophane. It was not possible in the dog to make observations of value concerning functional ability but the tendons appeared free. Due to an accident in 1939 many of the microscopic sections were destroyed. The photomicrographs shown were salvaged from the group and were fairly typical of them all.

Initially it was customary to surround a length of tendon by cellophane. Later the wrapping of a great length was discontinued because in one case it was considered that a necrosis of the tendon had taken place with its final rupture on tension. The necrosis was presumed to be due to inadequate nutrition from the cutting off of blood supply. The blood vessels could not invade the tendon

Case One. This patient gave a history of having lacerated the right little finger in January 1936. This was followed by infection for which a long palmar incision was used for drainage. When first seen six months later there was full motion at the metacarpo-phalangeal joint but no active motion at the interphalangeal joints and some limitation of passive motion. There was also a neuroma on a digital nerve in the palm and numbness of the adjoining sides of the ring and little fingers. Amputation was advised due to inconvenience experienced in his occupation. This was refused. At operation the digital nerve was repaired The superficial and deep tendons were adherent to each other and to the surroundings in the finger to a point opposite the proximal digital crease The superficial tendon was sacrificed. The deep tendon was freed and surrounded by a cellophane film. Splinting was applied until the commencement of motion in fourteen days. A

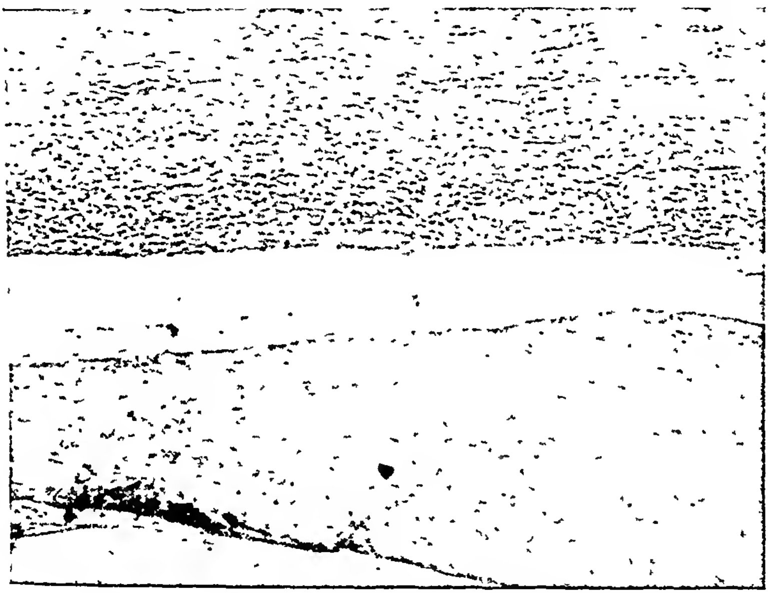

FIG. 3. IS A SPECIMEN FROM ANOTHER DOG SHOWING 300 PLAIN CELLOPHANE BETWEEN TENDON AND SURROUNDING TISSUES

There is practically no reaction on one side of the film with a mild increase in fibrous tissue on the opposite side. The cellophane showed some evidence of disintegration in other views in this section.

scab was then present at a point where a sharp change had been made in the direction of the incision. When motion was begun, a serous discharge commenced from this area, and continued until the cellophane was removed approximately six weeks from the time of operation. With regard to motion the end result was similar to the condition before operation.

Case Two. This patient was examined approximately one month after an accident which resulted in the amputation of the middle, ring and little fingers and injury to the index finger. The palmar surface of the middle phalanx of the index finger had a long oblique scar on it. Movement at the metacarpo-phalangeal joint was normal The proximal interphalangeal joint moved between 170° and 95°. There was no voluntary motion at the distal joint. At operation the deep flexor tendon was found intact and adherent to the surrounding tissues to the level of the proximal interphalangeal joint. There was no evi-

extrusion of foreign matter. In searching for a material with the least number of undesirable qualities, number 300 plain cellophane was used for lack of knowledge of something definitely better. This grade is less than one thousandth of an inch thick. Thicker grades are made in layers with an adhesive material between them. The moisture proof film has a coating which causes more tissue reaction. The cellophane can be sterilized easily by autoclaving or boiling. The impression was obtained that boiling might have been a factor in making the film less irritating. Boiling will certainly loosen the moisture proofing material if this

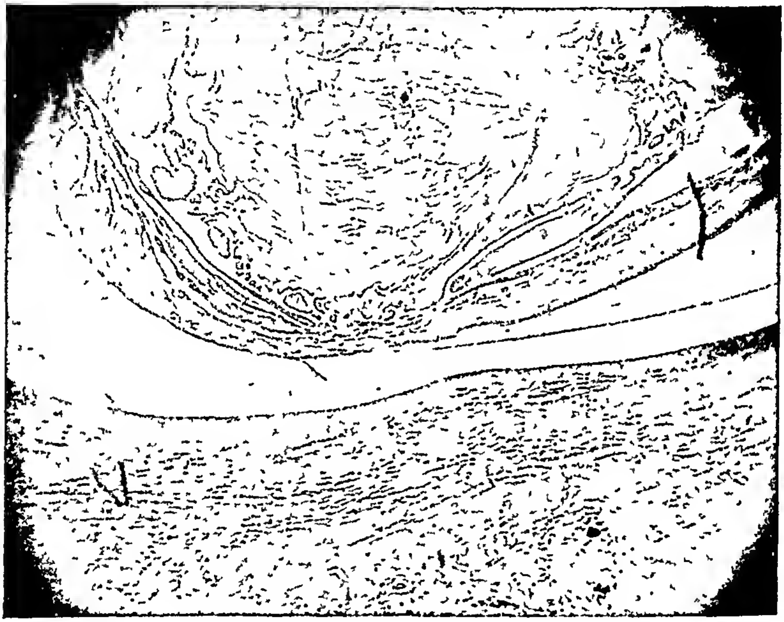

FIG. 2. SHOWS 450 GRADE CELLOPHANE ACTING AS AN INTERPOSITION FILM BETWEEN TENDON AND THE SURROUNDING TISSUES

In this case a dog's tendon and sheath had been damaged some weeks previously scraping and nicking with a scapel The cellophane was then placed about the tendon. Later the whole region was removed in one block for section There is a narrow dense fibrous tissue layer both on the surface of the tendon and next to the cellophane in the surrounding tissues

variety has been presented for use by mistake. The film will remain with little change in the tissues for years. It is flexible. It loses some of its tensile strength slowly, and occasionally fragments in the tissues. As there are other transparent wrapping films one must be assured of the nature of that which is presented for use.

The following are the histories of a few typical cases. They were selected purposely to show failures as well as successes. While these cases deal only with the hand flexor tendons, cellophane has been used as an interposition material in relation to the dorsal tendons and also in small joint arthroplasties.

cellophane implant It is advisable that such a strip be made longer than appears necessary, and that it reach well beyond any scarred region It may be that it should extend from the common flexor sheath to the insertion of the tendon Some poor results ensued from neglecting to suture carefully in layers over the implant, and allow firm skin healing before motion Good results have usually been apparent immediately the patient has commenced motion In no case did motion, which was immediately apparent, become gradually less indicating adhesions due to the increased production of dense fibrous tissue about the implant

Mayer and Ransohoff (2) attempted the prefabrication of a tendon sheath by the use of a celloidin tube Thatcher (3) used stainless steel rods to canalize for flexor tendon sheaths Wheeldon (4) after reviewing some of our early work published a case in which cellophane was used in conjunction with an operation on one of the extensors of the thumb It did not appear from the description given that criteria for the use of any interposition substance existed in the case presented McKeever (5) has used cellophane as an interposition substance in joint surgery In experimental work Johnson (6) used patches of absorbable film made from fetal membranes Penfield (7) also suggested the use of amniotic membrane as an aid in tendon surgery This had been used by him in brain surgery for the prevention of adhesions Frantz (8) suggested absorbable oxidized cellulose as a possibility in the repair of tendon sheaths Mazet and others have used tantalum foil This fragments very readily Blaine (9) has indicated the relative tissue reaction to many different types of plastic materials The very multiplicity of materials which have been used or suggested makes one realize that this problem is far from solved It may be that the control of the production of adhesions will eventually be by some entirely different mechanism Atraumatic surgery with freedom from infection and haematoma remain the best methods of treatment at present The increasing use of free tendon grafts and the replacement of scarred tissues by skin flaps is lessening the indications for use of interposition films

In conclusion experiences in the use of cellophane as an aid in tendon surgery have been described The use of an interposition substance appeared to be indicated in certain types of cases The ideal substance, autogenous tissue or foreign matter in the form of film has yet to be demonstrated Plain cellophane of a fine grade—sterilized by boiling has given an occasional good result but no technique has been found whereby these results can be uniformly produced If used, firm healing of the surrounding tissues should be obtained before motion is allowed

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dence of tendon sheath. It was freed and a slip of cellophane was placed underneath. The tissues were sutured in layers. Movement was commenced in twenty days. This patient was last examined one and a half years after operation. Movement at all joints was normal.

Case Three. This patient was seen in 1938 five months after an accident in which his right wrist was caught in a gear. In some manner the median nerve was not severed. The flexors to the fingers were reported to have been cut and the long flexor to the thumb partially cut. These were sutured. There was a discharge from the wound for some weeks. On examination the wrist flexed and extended between 145° and 170°. All fingers moved approximately through a similar range of motion. The metacarpophalangeal joint motion was only slightly less than normal. The proximal joints moved through a range of about 20°, and there was only a flicker of motion at the distal joints. This varied somewhat depending upon the position of the metacarpophalangeal joints. The interphalangeal joints of all fingers moved simultaneously, there being practically no ability to move fingers individually. The thumb was limited in abduction and movement of the metacarpophalangeal and interphalangeal joints depended on the position of the carpometacarpal joint.

At operation the median nerve was dissected free from a mass of scar tissue. The transverse carpal ligament was cut. The sublimis and profundus tendons were bound together and to their surroundings with dense fibrous tissue. There was a considerable amount of black foreign material present in this region. The tendons were separated from the surrounding tissues and a large piece of cellophane was placed about the tendon mass. Finger motion was commenced immediately and wrist motion in about two weeks.

On examination in two months time, wrist joint flexion was between 110° and 190°. The thumb had practically normal range of motion independently of any motion in the fingers. The fingers moved in an approximately similar manner. The metacarpophalangeal joint moved almost normally. The interphalangeal joints had an almost normal range when the metacarpophalangeal joints were extended. When the metacarpophalangeal joints were flexed the interphalangeal joints were limited so that the index finger flexed to within three quarters of an inch of the palm with improvement toward the little finger, which flexed to within one quarter of an inch of the palm. There was not a great amount of individual motion of the interphalangeal joints, it being necessary to flex all fingers simultaneously. This increase in motion represented a great improvement to the total function of the hand.

Case Four. This patient gave a history of tendon injury to the index finger due to a glass cut two months before examination. An immediate suture had been performed and this was followed by some infection. On examination there was acute flexion of the interphalangeal joints with no active motion. The joints could not be forcibly extended. The metacarpophalangeal joint moved approximately normally. At operation the superficial and deep flexor tendons were intimately associated with each other in a mass of scar tissue which was adherent to the metacarpal bone. After complete freeing the interphalangeal joints were placed in a more extended position and a slip of cellophane placed under them. Movement was commenced in two weeks. A very slight amount of motion was obtained at the proximal joint and none at the distal joint. The position of the finger had been improved and the patient was content with no more surgery. A free tendon graft would likely have given a better result and nothing of any value was accomplished with the interposition film.

Case Five. This patient sustained a laceration of the palm at the base of the little finger. A primary suture of the tendon was performed by his surgeon. On examination two months later there was approximately normal motion at the metacarpophalangeal joint. The interphalangeal joints were in some fixed flexion with a flicker of motion at the proximal joint and none at the distal joint. At operation the flexor tendons were freed and a slip of cellophane placed under them. When motion was commenced it was practically full in all joints immediately. The patient was seen five years later and had a normal finger.

The lack of uniformity of good results is difficult to explain. They are probably due to the adherence of tendon to surrounding tissues at the end of the

about a dental compound stent which has been carefully molded to the space between the hard palate and the mucoperiosteal flap. The flap is dissected back to the junction of the bony palate and the aponeurosis of the soft palate. The contour of the stent is oval on cross section and it should be trimmed until it is somewhat smaller than the cavity into which it will be inserted, so that when the mucoperiosteal flap is replaced, the margins of the wound can be approximated without tension. It is advantageous to use the stent, because the skin graft is kept in close contact with every irregularity of the mucoperiosteal flap and the bony palate so that a complete "take" is the usual result. Furthermore, the skin graft is prevented from contracting until the stent has been removed. The temporary application of a graft to the hard palate is useful if the second operation must be postponed for any reason, because in this way a skin lined cavity is formed and the development of granulations or infection of the palatal bone is prevented. In the usual sequence, the "push-back" procedure is carried out two or three weeks after the application of the skin graft. Formerly, it was considered to be necessary to sever the greater palatine arteries routinely to allow the flap to be retrodisplaced adequately, but we have found that in many cases it is possible to stretch the arteries and veins out of the posterior palatine foramina for a considerable distance. Occasionally, it is necessary to remove part of the posterior wall of the palatine foramina to avoid kinking of the vessels and to permit the palate to be "set-back" freely as has been described by Brown (5). When the second stage of the operation has been performed it is most important to trim the skin graft away from the margins of the palatal flap so as to provide a sufficient raw area for union with the posterior part of the palatal bone. The tip of the flap must be securely fixed with wire or dermal sutures to prevent it from creeping forward, and these should not be removed for several weeks. If the lateral margins of the flap cannot be conveniently approximated with sutures, it may be necessary to apply a wire cribwork or an acrylic splint to the teeth to ensure primary union of the lateral margins of the flap. The palatal cleft is closed in the usual manner at the same time as the retrodisplacement procedure is carried out. We believe that palatal massage started four to six weeks after the final operation is helpful in mobilizing the palate (6).

1. Congenital short palate, cleft of the soft palate, and cleft of the soft palate and part of the hard palate

In these three types of palatal defect the same method of operation may be employed. A U-shaped incision is made from the molar region on one side around to the opposite molar tooth. This is placed about 3 or 4 mms. from the gingival margins of the teeth. The mucoperiosteal flap is raised and freed posteriorly as far as the major palatine arteries and the aponeurosis of the soft palate. A dental compound stent is shaped to fit the cavity and permit the mucoperiosteal flap to be approximated over it. The stent is now covered with a skin graft, raw surface outward, and this is inserted beneath the mucoperiosteal flap which is sutured over it. Two or three weeks later the flap is again raised

A METHOD OF MINIMIZING CONTRACTURE FOLLOWING CLEFT PALATE OPERATIONS*

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The history of the development of operative procedures on cleft palate is a fascinating subject. Some idea of the immense amount of work which has been devoted to this problem may be gained by study of Dorrance's book "The Operative Story of Cleft Palate" which lists 87 pages of references. Since many surgeons working independently have sometimes reported new methods almost co-incidentally, no one man can lay complete claim to an operative procedure, since tribute must be paid to the experiences of preceding and contemporary surgeons whose efforts have provided the foundation on which some technical refinement is based. The usual methods of surgical repair of cleft palates frequently fail to establish normal speech even after adequate periods of speech therapy. In many cases this is due to the anterior pull of the contracting raw surface on the nasal aspect of the mucoperiosteal flaps which causes a "short palate." When healing has occurred, the contracted scar tissue prevents the velum from closing the velopharyngeal sphincter and the patient's speech remains defective. Many ingenious methods have been devised in an attempt to overcome this difficulty. Some of these operations are formidable, others time consuming, and a few result in a high percentage of failure.

In 1921 Gilles (1) reported a new splint for applying skin grafts to the *anterior* raw surface of the soft palate after it had been retrodisplaced. The anterior defect in the hard palate was closed by means of an obturator. Baxter (2) described a method of using stent grafts to line the *nasal side* of the mucoperiosteal flap prior to a "push-back" or "set-back" operation to minimize subsequent contracture of the palate. Dorrance (3) outlined in great detail a method of suturing skin grafts to the mucoperiosteal flap in seven types of defect of the palate. Pressure was applied to the grafts by a special type of splint which was devised by Gross (4). During the past five years we have observed certain advantages and some technical difficulties which have arisen as a result of applying skin grafts to the palate. We have modified the original procedure and it has been employed in a variety of cleft palate defects.

METHOD

The essential principle involved is that of applying an epithelial covering to the raw surface on the nasal side of the mucoperiosteal flap. The split skin graft, taken from a hairless area of the body is wrapped, raw surface outward,

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as the posterior palatine foramen on each side. A skin graft covered stent is inserted in the same manner on either side as described in the previous procedure. Several weeks later the mucoperiosteal flaps are raised, the stents are removed and the incisions are joined anteriorly and are then extended posteriorly around the tuberosities of the maxilla. The skin grafts on the palatal bone are stripped

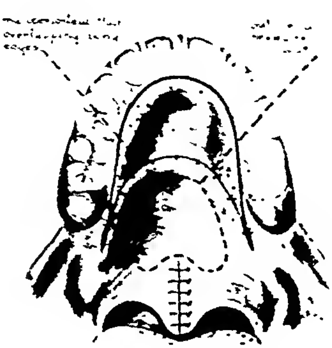


Fig. 5

Fig. 6

Fig. 5. The Retrodisplaced Palate Flap has been Sutured to the Posterior Border of the Palatal Bone and the Cleft in the Palate has been Repaired

Fig. 6. Pre-operative Position of Stent

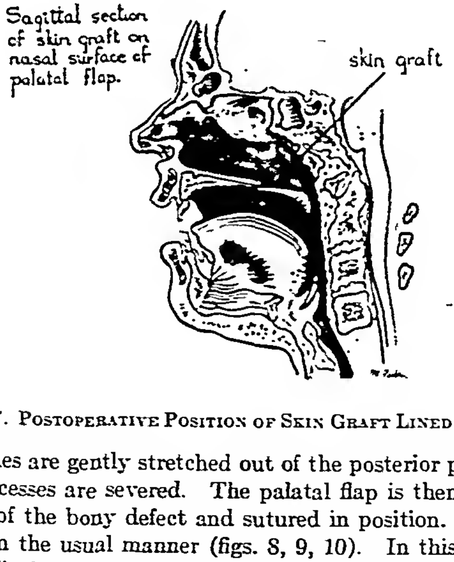
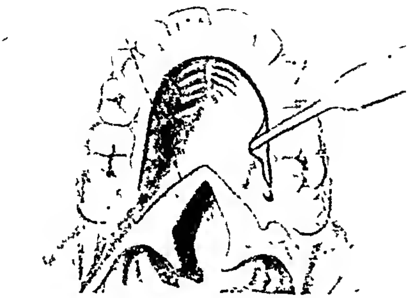


Fig. 7. Postoperative Position of Skin Graft Lined Flap

off, and the arteries are gently stretched out of the posterior palatine foramina. The hamular processes are severed. The palatal flap is then displaced to the posterior border of the bony defect and sutured in position. The cleft of the palate is closed in the usual manner (figs. 8, 9, 10). In this type of case the amount of retrodisplacement is not as extensive but the presence of the skin graft on the nasal side of the mucoperiosteal flap greatly reduces the amount of postoperative contracture.

through the original incision, the stent is removed and the skin graft which has united to the bony palate is stripped off without injuring the part of the skin graft which has become attached to the mucoperiosteal flap. The incisions are now carried around the tuberosity of the maxilla and some distance posteriorly. The hamular processes are then divided. The aponeurosis is severed from the palatal bone and the arteries are carefully stretched out of the foramina and freed from the palatal flap as much as possible. If necessary, the posterior



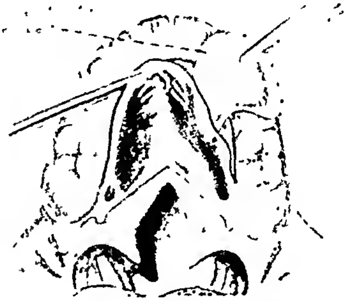


FIG. 1 FIG. 2

FIG. 1. ELEVATION OF MUCOPERIOSTEAL FLAP, THROUGH A U-SHAPED INCISION

FIG. 2. INSERTION OF SKIN GRAFT COVERED STENT BENEATH MUCOPERIOSTEAL FLAP

FIG. 3 FIG. 4

FIG. 3. MUCOPERIOSTEAL FLAP SUTURED OVER STENT

FIG. 4. MUCOPERIOSTEAL FLAP RAISED WITH ATTACHED SKIN GRAFT PREPARATORY TO "SET-BACK" OPERATION. THE SKIN GRAFT ATTACHED TO THE PALATAL BONE HAS BEEN REMOVED

walls of the palatine foramina may be carefully removed with a chisel. The tip of the retrodisplaced flap is sutured to the posterior border of the palatal bone with wire or dermal sutures. The cleft of the palate is closed in the usual manner (figs. 1, 2, 3, 4, 5, 6, 7).

2. Cleft of the hard and soft palate extending to the alveolar ridge

In this type of cleft the vomer is frequently rudimentary. An incision is made close to the gingival margin of the teeth and carried posteriorly as far

yet remains a speech cripple due to a short, contracted palate. In these patients a "push-back" may fail to accomplish the desired speech result because of

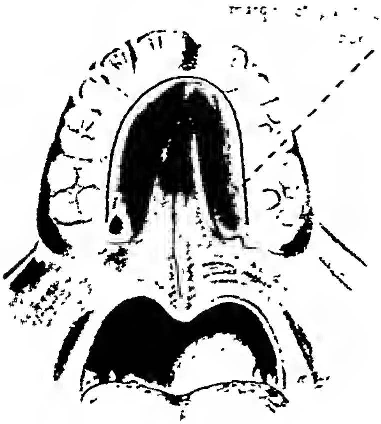


Fig. 11

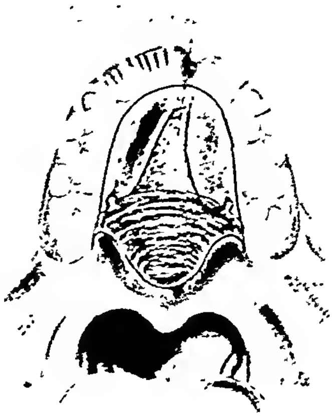


Fig. 12

Fig. 11. Type of Incision Employed when a Short, Contracted Palate is Present after Primary Repair

Fig. 12. Splitting of the Mucoperiosteal Flap without Perforation into the Nasal Cavity

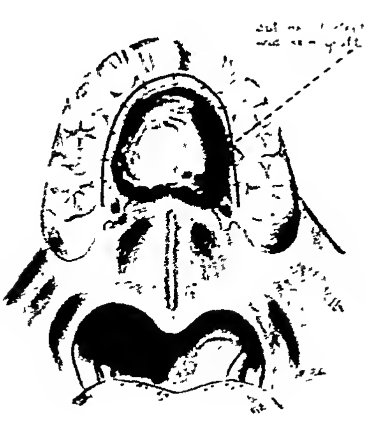


Fig. 13

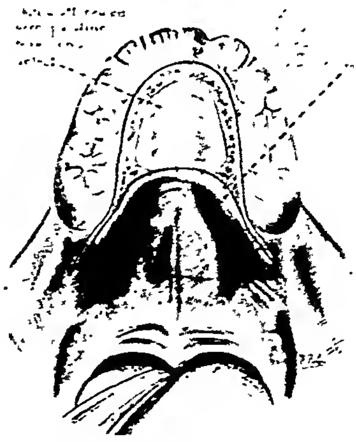


Fig. 14

Fig. 13. Mucoperiosteal Flap Re-sutured over Stent Graft

Fig. 14. "Set-back" of Skin Graft Lined Flap

contracting scar tissue which draws the palate forward. In selected cases it may be possible to split the mucoperiosteal flap without penetrating into the

3. Bilateral complete cleft palate

The method described by Dorrance of reflecting flaps of mucous membrane bilaterally from the vomer to close the anterior part of the defect is very satisfactory. After the anterior portion has filled in with granulations, muco-

Fig. 8

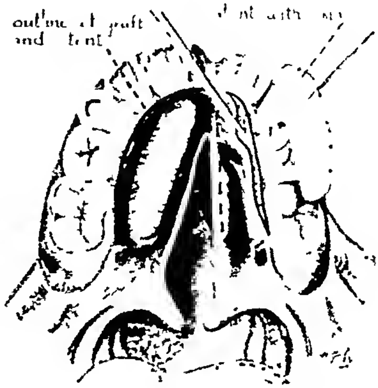


Fig. 9

Fig. 8. Type of Incision Employed when Cleft Extends to Alveolar Ridge
Fig. 9. Two Skin Graft Covered Stents are Inserted, One on Each Side of the Cleft

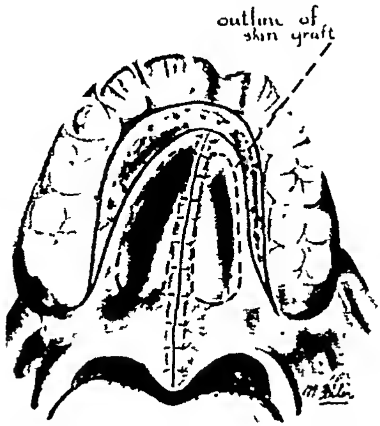


Fig. 10. Postoperative Position of the Flap

periosteal flaps may be raised, lined with skin grafts and subsequently retrodisplaced.

4. Secondary repairs

One of the major problems encountered in cleft palate surgery is the patient who has had a single or double cleft repaired by the Langenbeck procedure and

Postoperative Speech Examination: At the end of the course of therapy the patient's speech was entirely normal. The only remaining evidence of the facial grimaces was slight nasal twitch on sounding "S".

Nasopharyngoscopic Examination (November, 1946): The skin graft was smooth, flexible and was beginning to undergo metaplasia.

Case: D. C. Age 6 years. I.Q. 100 (normal 100)

Diagnosis: Cleft of soft and half of hard palate. (Photograph No. 4)

Pre-operative Speech Examination: Cleft palate type speech was present. The plosives, sibilants and fricatives were all lost with glottal substitutes.

Operations: 1. July 10/46—Stent skin graft to mucoperiosteal graft. 2. July 24/46—"Set-back" of palate and closure of cleft. The major palatine arteries were saved. (Photograph No. 5)

Photograph No. 3

Photograph No 4

Photograph No. 3. Small Hole at Junction of Hard and Soft Palate, Probably Caused by Inclusion of a Piece of Skin Graft in Suture Line, which Required Secondary Repair

Photograph No. 4. Showing Cleft of Palate Pre-operatively

Postoperative Speech Examination: The patient is attending speech clinic All consonants were articulated perfectly. Some nasal resonance was present on vowels and there is a low "S".

Nasopharyngoscopic Examination (November, 1946): The skin graft was white, smooth and no raw areas were visible.

Case: D. W. Age 13 years. I.Q. 100 (normal 100)

Diagnosis: Previous complete cleft lip and palate on left side. The lip and palate had been repaired but the latter was short and had a hole in the soft palate. The patient was referred for repair. (Photograph No. 6)

Pre-operative Speech Examination: There was over-all general nasal resonance on vowels. The plosives were distorted with glottal substitutions, and the sibilants and fricatives were glottalized.

nasal cavity and insert a skin graft lined stent. The U-shaped flap is subsequently retrodisplaced in a manner similar to that described in method one (figs. 11, 12, 13, 14).

CASES

The following cases illustrate the method of treatment of various types of palatal defects and the speech results which have been obtained.

Case: J. M. Age 6 years. I.Q. 82 (normal 100).
Diagnosis: Congenital short palate.
Pre-operative Speech Examination: Cleft palate type speech was present. The plosives, sibilants and fricatives were all lost, with glottal substitution.
Operations: 1. June 13/45—Stent skin graft to mucoperiosteal flap. 2. June 27/45—"Set-back" of palatal flap, the major palatine arteries were saved.

PHOTOGRAPH NO. 1 PHOTOGRAPH NO. 2

PHOTOGRAPH NO. 1. POSTOPERATIVE RESULTS, SHOWING MARKED AMOUNT OF RETRODISPLACEMENT OF MUCOPERIOSTEAL FLAP OBTAINED

PHOTOGRAPH NO. 2. WIDE CLEFT OF SOFT AND HALF OF HARD PALATE WITH RUDIMENTARY VOMER, SHOWN PRE-OPERATIVELY

Postoperative Speech Examination: After a course of speech therapy, a test showed that the patient's speech was perfect except that the "S" had changed from a glottal stop to a dental lisp. (Photograph No. 1)
Nasopharyngoscopic Examination: The outline of the skin graft to the nasal aspect of the mucoperiosteal flap was easily observed. A considerable degree of metaplasia had occurred and the graft was pinkish in color and appeared to be soft and flexible.

Case: M. F. Age 13 years. I Q. 109 (normal 100)
Diagnosis: Cleft soft palate and half of hard palate. (Photograph No. 2)
Pre-operative Speech Examination: General nasal blurr on all vowels. The worst consonants were the sibilants. Nasal grimaces accompanied all of these sounds.
Operations: 1. July 25/45—Stent skin graft to mucoperiosteal flap. 2. Sept. 7/45—"Set-back" of palate and closure of cleft. The major palatine arteries were saved. 3. Nov. 29/45—Repair of small hole in palate. (Photograph No. 3)

Postoperative Speech Examination: At the end of the course of therapy the patient's speech was entirely normal. The only remaining evidence of the facial grimaces was slight nasal twitch on sounding "S".

Nasopharyngoscopic Examination (November, 1946): The skin graft was smooth, flexible and was beginning to undergo metaplasia.

Case: D. C. Age 6 years. I.Q. 100 (normal 100)

Diagnosis: Cleft of soft and half of hard palate. (Photograph No. 4)

Pre-operative Speech Examination: Cleft palate type speech was present. The plosives, sibilants and fricatives were all lost with glottal substitutes.

Operations: 1. July 10/46—Stent skin graft to mucoperiosteal graft. 2. July 24/46—"Set-back" of palate and closure of cleft. The major palatine arteries were saved. (Photograph No. 5)

PHOTOGRAPH NO. 3

PHOTOGRAPH NO. 4

PHOTOGRAPH NO. 3. SMALL HOLE AT JUNCTION OF HARD AND SOFT PALATE, PROBABLY CAUSED BY INCLUSION OF A PIECE OF SKIN GRAFT IN SUTURE LINE, WHICH REQUIRED SECONDARY REPAIR

PHOTOGRAPH NO. 4. SHOWING CLEFT OF PALATE PRE-OPERATIVELY

Postoperative Speech Examination: The patient is attending speech clinic. All consonants were articulated perfectly. Some nasal resonance was present on vowels and there is a low "S".

Nasopharyngoscopic Examination (November, 1946): The skin graft was white, smooth and no raw areas were visible.

Case: D. W. Age 13 years. I.Q. 100 (normal 100)

Diagnosis: Previous complete cleft lip and palate on left side. The lip and palate had been repaired but the latter was short and had a hole in the soft palate. The patient was referred for repair. (Photograph No. 6)

Pre-operative Speech Examination: There was over-all general nasal resonance on vowels. The plosives were distorted with glottal substitutions, and the sibilants and fricatives were glottalized.

Photograph No. 5

Photograph No. 6

Photograph No. 5. Retrodisplaced, Skin Grafted Flap, One Month Postoperatively, Before It had Smoothed out Completely

Photograph No. 6. This Patient was Referred to the Clinic for Treatment. The Previous Operator had Obtained a Short, Tight Palate with a Large Perforation in the Soft Palate

Photograph No. 7

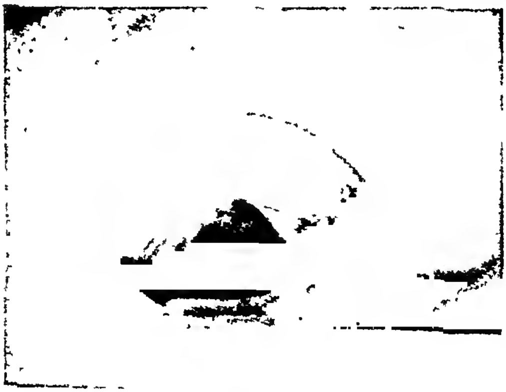
Photograph Nos. 7 & 8. Photographs Taken a Few Weeks after the Final Operation Show the Amount of Displacement Backward and Closure of the Perforation. He is Showing Rapid Progress in the Speech Clinic

Operations: 1. Stent skin grafts were used to line the mucoperiosteal flaps. The Wardill incision was used anteriorly while on the posterior half of the hard palate the mucoperiosteal flap was split as has been described by Dr. James B. Brown. 2. Since the major palatine

arteries had been severed by the previous operator, a "push-back" of the palate was performed. At the same time the hole in the soft palate was repaired. (Photographs Nos. 7 and 8)

Postoperative Speech Examination: One month after the last operation the patient was admitted to the speech clinic. A test at this time showed that all consonants were articulated perfectly. There was nasal resonance on all vowels with a velar "K" and "G" and a low "S". The palate was long and a good speech result was anticipated.

PHOTOGRAPH NO. 8



PHOTOGRAPH NO. 9. THIS PATIENT SURVIVED AN ATTACK OF DIPHTHERIA AS A CHILD BUT SUFFERED EXTENSIVE SLOUGHING AND SCARRING OF THE SOFT PALATE

Nasopharyngoscopic Examination (November, 1946): The grafted area appeared as a moist, opaque, white area. There was no crusting and no raw areas were visible.

Case: A. W. Age 26 years. I.Q. 90 (normal 100)

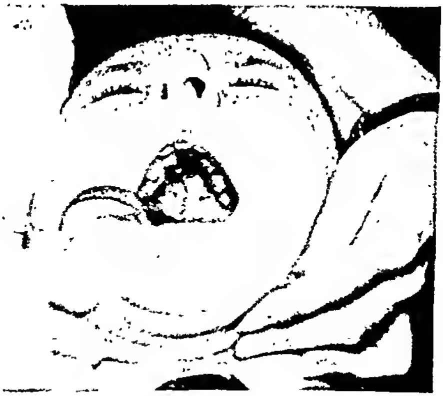
Diagnosis: As the result of diphtheria when the patient was 9 years old the uvula and part of the soft palate had sloughed with extensive residual scarring. (Photograph No. 9)

Photograph No. 5

Photograph No. 6

Photograph No. 5. Retrodisplaced, Skin Grafted Flap, One Month Postoperatively, Before It had Smoothed out Completely

Photograph No. 6. This Patient was Referred to the Clinic for Treatment. The Previous Operator had Obtained a Short, Tight Palate with a Large Perforation in the Soft Palate



Photograph No. 7

Photograph Nos. 7 & 8. Photographs Taken a Few Weeks after the Final Operation Show the Amount of Displacement Backward and Closure of the Perforation. He is Showing Rapid Progress in the Speech Clinic

Operations: 1. Stent skin grafts were used to line the mucoperiosteal flaps. The Wardill incision was used anteriorly while on the posterior half of the hard palate the mucoperiosteal flap was split as has been described by Dr. James B. Brown. 2. Since the major palatine

1. The application of a skin graft to the raw surface on the nasal aspect of the mucoperiosteal flap in selected types of palatal defects appears to be a satisfactory procedure, both theroretically and also as far as can be determined from a limited number of cases.

2. We have found that it is technically, extremely difficult to successfully cover the raw nasal surface with retrodisplaced flaps of mucosa, from the palatal bone as advocated by some surgeons.

3. In all cases examined by the nasopharyngoscope the graft was found to be viable and there was no evidence of crusting or offensive odor. Grafts over a year old had developed a pinkish color and one graft which was five years old had evidently undergone considerable metaplasia for only a faint whitish tinge differentiated the graft from the surrounding mucosa. No opportunity has yet occurred to biopsy these skin grafted palates.

4. Certain technical complications have been noted following this type of operation and some measures to reduce their incidence have been described.

The speech results obtained after this type of operative procedure and the usual period of speech training, were definitely better than those observed following the ordinary operative procedures.

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Pre-operative Speech Examination: There were glottal substitutions for the plosives and there was nasal resonanee on all vowels. The sibilants were nasalized.

Operations: 1. June 15/40—Ligation of major palatine arteries. 2. Feh. 18/41—Stent skin graft to mucoperiosteal flap. 3. Mareh 10/41—"Push-hack" of palate flap.

Postoperative Speech Examination: The patient was unahle to attend the speech clinic. Five years postoperatively a test showed that all consonants were good although there was some nasal resonance on the vowels. A course of speech therapy is now being givea to correct this slight residual defect. (Photograph No. 10)

Nasopharyngoscopic Examination (November, 1946): The skin graft eould only be differentiated from its surrounding mucosa by a pale whitish tinge.

Note: Due to the pressure of a full upper denture which the patient has been using for the past five years and perhaps due to a process of metaplasia, it was difficult to recogaize the presence of the skin graft whieh had heen applied to the *oral surface* of the hard palate, and which in this case was not removed.

PHOTOGRAPH NO. 10. THE TIP OF THE MUCOPERIOSTEAL FLAP IS SHOWN OVERLAPPING THE POSTERIOR BORDER OF THE HARD PALATE BY ONLY A FEW MILLIMETRES. THE PATIENT WEARS A FULL DENTURE WITH COMFORT

SUMMARY

Skin grafts have been applied to the nasal aspect of the mucoperiosteal flaps in 12 patients. In one case the skin graft failed to take. Since then sodium penicillin in physiological saline solution containing 25,000 units per cc. has been injected about the stent and skin graft before suturing the flap back into place. This precaution against infection combined with careful fitting of the stents probably accounts for the fact that all subsequent grafts have been taken completely. Primary union occurred after closure of the clefts in all cases except one where a small hole the size of a grain of wheat remained. This was probably due to the inclusion of a small piece of skin graft in the suture line when the cleft was repaired. In two patients the mucoperiosteal flaps failed to unite primarily with the lateral margins of the palate. This complication was probably caused by insufficient trimming of the skin graft from the margins of the flap. Secure fixation of the flap by suture, by the pressure of a wire, or acrylic splint is important, to obtain close contact of the raw margins.

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SURGICAL TREATMENT OF BURNS: USE OF PRESSURE DRESSINGS

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The surgical principles involved in the treatment of burns have been expressed very concisely by Allen and Koch (1). They are:

1. To prevent and combat shock.
2. To convert the open contaminated wound into a clean wound.
3. To cover the open wound by the simplest possible dressing that (a) protects it from the constant danger of reinfection; (b) does not fix or destroy any part of the skin or subcutaneous tissue which remains viable when the patient is first seen; (c) provides for drainage of the serum that exudes from the burned surface until it is checked by pressure or the normal process of coagulation; (d) exerts a uniform moderate pressure easily removed if infection develops underneath the dressing or if the burn involves the whole thickness of the skin.
4. To keep the injured part at rest.
5. To secure healing in the minimum period of time and with minimal loss of function.

When treating burns, first consideration should be given to the treatment of shock, the causes of which are reviewed by Berman (2) as follows: "As a result of the injury there is an increased permeability of the capillary endothelium permitting the escape of plasma into the burned area. This leads to hemoconcentration which in turn causes a stagnant anoxemia to occur. As anoxemia increases, tissue cells are damaged, especially in the brain, heart and blood vessels. Capillaries begin to lose fluid in many areas."

In reviewing the literature one finds many different types of dressings which have been used in the treatment of burns, each having its adherents. The closed methods represented by applications of tannic acid, silver nitrate, gentian violet, or triple dye are challenged by a variety of open methods including vaselined gauze and compression dressings Koch (15) and Mason (17) sulfanilamide powder and vaselined gauze (Colebrook (6)), saline compresses, and sodium hypochlorite irrigations with the aid of oiled silk envelopes as described by Douglas (9). Recently, Connor and Harvey (7) have advocated the use of pyruvic acid starch paste. So far the results are promising but yet to be evaluated.

In regard to the dye and tannic acid methods Cannon and Cope (5) write that "tannic acid and dyes have represented improvements in the treatment of burned patients, but it must be recalled that their recent introduction has coincided with the understanding of protein and fluid therapy. The attention of those recommending tannic acid or dyes has been so riveted on fluid loss, toxins, or infection that they have neglected the possible noxious effect of the

substances upon the viable epithelium." It must be remembered that subsequently Hartman and Romence (14) have shown that there is massive destruction of the liver due to the toxic effect of the tannic acid. As a result of these findings it is felt that the use of tannic acid should be abandoned.

Blair (3) lists four advantages from the application of pressure dressing: (1) elimination of dead space, (2) the control of oozing, (3) the limitation of venous and lymph stasis and (4) the elimination of the amount of plastic material that pours into the wound. The author has pointed out that another important advantage of the pressure dressing is the splinting effect which it lends to the soft tissue involved, keeping the part immobile and at complete rest. This factor serves to aid in wound healing and to protect the surgically clean wound against potential contamination for a long period with the elimination of the greater part of the usual intense pain.

The use of a properly applied pressure dressing in the treatment of burns lends itself to the application of an ideal method of treating this condition, since it incorporates basic fundamentals which insure the application of physiologic principles. Allen and Koch (1) describe an important physiologic principle involved in the use of an adequate pressure dressing in the treatment of burns:

> The elimination of dead space into which constant oozing can take place and the limitation of exudation from the surface of a wound *and into the subcutaneous tissues* are important objectives in wound treatment which are too often completely ignored. The surgeon who sees blood escaping rapidly from an open wound instinctively applies pressure to stop the bleeding and conserve vital body fluid. By some curious inconsistency if we *cannot see it* we may ignore the subcutaneous bleeding that goes on just as definitely after the subcutaneous rupture of blood vessels and continues until it is arrested either by coagulation or by actual compression of the injured blood vessels by the tensed body tissues.
>
> If the subcutaneous bleeding is the 'white hemorrhage' that goes on in tissues injured by a flame or scalding water, it needs to be arrested just as promptly as if the blood were escaping from a torn blood vessel. It can be arrested, and body fluid saved by the application of pressure over the injured area.

Owens and Patterson (18) have shown experimentally the beneficial results which follow the application of pressure dressings to large burned areas in combating shock. They have demonstrated that immediate application of pressure to these open wounds forces the tissue fluids, the "white bleeding," back into the vascular bed. They also clearly demonstrated its efficacy in combating shock as reflected by an almost immediate rise in blood pressure following its application. As a result of this alteration it has also been shown that the plasma requirements of these patients is proportionately reduced.

In speaking of the compression method of treatment Brantigan (4) states that it "permits immediate protection of the burned areas from further contamination and injury; it makes the control of shock easier; the blood proteins can be maintained more easily; less aftercare is required; no eschar or coating agent need be removed; and skin grafting can be done earlier." Siler and Reid (21) state that "the decrease in the amount of suffering by this method of treatment seems to be very striking. Rarely is it necessary to continue to use morphine or codeine for more than a day or two after operation. The patients can move about much more easily. The nursing problem is greatly simplified. There is a great saving in the cost of dressing materials when compared with

other methods, which require frequent dressings or compress therapy. The temperature charts seem to us to show a surprisingly rapid return to normal levels."

TREATMENT OF THE BURN PATIENT

As soon as a burned patient is received, immediate attention should be directed towards determining the presence or absence of shock. Blood for complete blood count and haemoglobin determinations as well as for hematocrit, serum protein and blood chemistry determinations should be taken immediately. These initial determinations establish for that particular patient a base with which subsequent determinations may be compared. If shock is present or seems imminent, prompt measures should be instituted and the local and general care correlated. The local application of pressure diminishes the flow of plasma from the burned area into the surrounding tissues and aids in preventing shock. Systemically, the administration of morphine helps to allay pain and anxiety. In the early shock phase the infusion of plasma to prevent hemoconcentration and to establish a safe physiologic balance is fundamental. The alteration in the patient's physiologic state with regard to hemoconcentration, contrary to the opinion of many, may be dramatic and occur within one to two or three hours and must be determined by frequent examination of the hematocrit and haemoglobin level. As soon as it is established that the hemoconcentration is reduced to the physiological level, transfusion of whole blood should be given and continued throughout the course of treatment because these patients develop a secondary anemia. The maintenance of adequate temperature of from 72 F. to 80 F. and avoidance of excessive heat aid in preventing shock.

Local treatment of the burn should be administered as soon as possible. Application of a pressure dressing diminishes the flow of plasma from the burned area into the surrounding tissues and aids in preventing shock. On the basis of observation and experience the following plan of procedure is advocated. All personnel should be properly gowned, sterile gloves should be used and masks of sufficient thickness to insure minimal contamination should be worn over the mouth and nose. All unnecessary traffic in the operating room should be prohibited and a minimum of attendance permitted. Doors should be opened only when actually necessary. Extreme care should be taken at all times to protect the patient against all potential contamination arising from contact with external objects, unnecessary contact with dust, contaminated wards, and, above all, with contamination from the medical personnel through unmasked nose or mouth. Hare (13) has conclusively demonstrated the importance of avoiding these common sources of contamination and has shown that too often the attending physician is the chief offender. The same protection should be afforded that would be given any patient who is to have a major operation. Mason (17) states that in the treatment of burns "one factor which has been insufficiently considered is that of the contamination of the large raw surface. The aim has been to cover it with something as rapidly as possible, ignoring the fact that the surface is already liberally contaminated with dirt and bacteria from the nose and throat of everyone who examines it."

The patient should be given sufficient morphine (usually $\frac{1}{4}$ grain) for analgesia. Intravenous morphine by the technique followed by Eichold has been quite satisfactory when administered to this type patient. In severly burned patients or patients in extreme shock the use of the drug intravenously is doubtless much safer when considering that morphine given subcutaneously may be inadequately absorbed during the shock phase and as the blood pressure rises, a latent amount unabsorbed in the tissues, may be drawn into the circulation without warning or without anticipation on the part of the surgeon or anaesthetist administering the drug.

Preparation should then be instituted for rendering the open contaminated wound an open surgically clean one. All clothing should be removed with the least possible amount of contamination or trauma to the patient, the clothes being cut off with sharp scissors if necessary. The patient should then be placed on sterile sheets. All burned areas should be gently washed with large pads of sterile absorbent cotton dipped in thick suds made with sterile water and a neutral white soap. The process is in no sense one which requires scrubbing; on the contrary, it should be carried out gently by slow rotary motion. This cleansing usually should be continued for a period of from ten to twenty minutes. The shorter time is probably more desirable, since it is the opinion of many that cleansing for more than ten minutes might be sufficient to force organisms into the deeper skin elements, thus producing infection of the deeper layers which might otherwise have been avoided.

After the area has been thoroughly cleansed, the surgical personnel, as well as the patient, should be redraped in preparations for the final cleansing. All vesicles which have persisted during the initial cleansing should be opened and drained. All loose skin and remaining pellicles from vesicles should be removed by sharp dissection and the surface of the burned area should be gently rinsed with warm normal saline solution. By this time, provided the surgeon has adequately cleansed the burned surface, the contaminated wound should have been converted into a surgically clean wound. The traumatized surface is then ready for the reception of a dressing designed to close the open wound. On the basis of more recent experience, it is probably more judicious, provided the patient has not been subjected to too much contamination, to avoid any surgical cleansing and to immediately apply a pressure dressing with no further disturbance to the patient. If there is the question of the patient's general condition and shock or impending shock is present or if the patient has extensive involvement the application of the pressure dressing without cleansing is indicated. In so doing the patient receives a minimum amount of disturbance and the application of the pressure dressing probably combats shock more quickly than any other acceptable method of treatment. In our experience, when this technique has been followed, the incidence of infection has been surprisingly low and no severe infection has been encountered.

APPLICATION OF THE PRESSURE DRESSING TO UNINFECTED BURNS

The first step in the application of the pressure dressing is to cover the entire burned surface with one single layer of rayon (20). The author uses rayon be-

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corporate varying numbers of Dakin's tubes between the layers of the gauze forming the dressing. This dressing should be tailored in a manner which permits it to be made as a single unit, holding the incorporated Dakin's tubes fixed in their proper places between the layers of gauze by a basting stitch of cotton thread. The ends of the Dakin's tubes which extend beyond the margin of the dressing should be connected to a glass tube with multiple outlets. The large open end of this glass unit should then be connected to a rubber tube which is attached to an infusion bottle. A closed system for irrigation, similar to that used in administering saline infusions or transfusions, is thus established. On the patient's return to the ward, sterile normal saline solution or 2% solution of acetic acid buffered to a pH of 4 with sodium acetate should be run through the connecting tube into the incorporated dressing from the bottle held above the level of the patient. This can be done by releasing a clamp which is applied to the main rubber connecting tube. A sufficient amount of the solution should be permitted to flow from the bottle into the dressing to give the patient a sensation of moisture. This procedure usually requires the instillation of 25 to 50 cc. of solution into the large dressings, two to three times daily. During extremely hot weather, instillations should be reduced to one every twenty-four hours in order to diminish the possibility of wound maceration since excessive maceration seems to enhance the growth of Bacillus pyocyaneus.

By means of this technic one can establish sufficient moisture in the composite dressing to convert it into a capillary drainage unit establishing drainage from the wound up into the substance of the dressing itself. These dressings should be changed every two or three days and at each change the patient should be adequately protected against potential contamination. While dressings are being changed, the wounds may be gently cleansed with pledgets of moist cotton and soapsuds.

Capillary drainage dressings permit more rapid conversion of an infected wound into a clinically clean one and the application of pressure over the dressing helps to reduce the infection and to keep the granulated surface firm, flat and free of edema. This pressure also aids in *minimizing associated scarring* which frequently results if pressure has not been applied.

Throughout the preoperative period careful attention is given to ascertaining that the patient's nutritional state is maintained and that adequate protein, carbohydrate, and vitamins are provided. Efforts to maintain the patient's morale are worthwhile. Cognizant of the secondary anemia suffered by burn patients haemoglobin is frequently checked and transfusions administered when indicated. Care is displayed with regard to the use of the sulfonamides and antibiotics. We are of the opinion that there is definite danger associated with the administration of the sulfonamides to a patient with a previously damaged kidney, the most constant pathological finding in patients dying of severe burns. Penicillin is not routinely administered but is of considerable value in minimizing the extension of infection and controlling pulmonary complications. A favorable response in a few patients to whom the drug is administered provokes a tendency for routine administration and caution should be exercised.

cause it is one of the kindest materials to open, granulating surfaces; the drainage is adequate; the coefficient of friction is very low and its weave is sufficiently fine to block capillary invasion. This rayon should be moistened with normal saline solution only, because the author believes that the application of any greasy substance to this dressing will interfere with drainage. Over this single layer of saline-moistened rayon is placed a layer of coarse-mesh, dry gauze about an inch in thickness in order to give body to the dressing These two layers are wrapped snugly with a roll of gauze 3–6 inches in width depending on the size of the dressing and the anatomical location. This is completely surrounded by a layer of water proof cellophane of sufficient size to permit an overlap of the pressure dressing at either end. This cellophane around the entire pressure dressing serves a definite purpose. Following this an ace bandage is used to afford compression. Care should be exerted in the application of the ace bandage that the pressure is not too great. To those accustomed to the roll gauze pressure there is a tendency to apply it in the same manner and excessive pressure can cause necrosis.

We wish to stress the inclusion of the cellophane layer because it has been shown experimentally that outside contamination can reach a wound through 64 thicknesses of gauze, moistened with either saline or plasma. When one single thickness of moisture proof cellophane was interspersed in the gauze column, in every instance sterile cultures were obtained. Hence the importance of interspersing a mechanical barrier designed to protect the wound against invasion through the dressing itself.

The patient should then be placed in bed over sterile sheets where he should remain until time for the dressing to be changed. The first dressing should be changed at the end of 18 to 21 days. The rationale for this delay is based on the assumption that a first, second, or partial third degree burn, at the level of the papillary peg layer, should be healed within 14 to 16 days, provided no infection has developed. A burn sufficient to produce a thick eschar with complete skin loss would not show a separation of the viable from the non-viable skin before 18–21 days. The author feels, therefore, that the patient should be adequately protected during this maximum period. An earlier change of dressing would reveal a healed wound in the first group or an incompletely separated slough, if complete skin loss has been encountered. Nothing would be gained by an early change of dressing except to establish these facts. To change the dressing at an earlier date would subject patients with complete skin loss to one unnecessary exposure. When the first dressing is removed at 18 to 21 days one is frequently able to apply skin grafts to those cases with complete skin loss and subsequent complete slough at this time. Following the grafting procedure dressings should be applied in the operating room with all necessary precaution to protect the patient against contamination.

INFECTED BURNS

In cases of infected burns the identical technic already described should be followed, with the additional application of a formed dressing designed to in-

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RATIONALE FOR THE USE OF PRESSURE DRESSINGS

In surgically clean or in infected wounds the advantages of using one layer of rayon moistened with saline solution is threefold: It minimizes the penetration of capillary buds into the substance of the dressing; it permits removal, when moistened with normal saline solution, with a minimum amount of pain and bleeding; and it permits constant drainage. This dressing also affords more comfort to the patient while being worn. Although some believe that grease dressings facilitate drainage, the author has found that they interefere with adequate drainage. If wounds are free of infection and completely healed, it is not at all uncommon to find a layer of rayon entirely dry and adherent to the surface of the wound. In infected wounds treated with capillary dressings this layer of rayon is usually moist and adequate drainage occurs. Another noteworthy feature is the absence of foul odor that lowers the patient's morale and is an important cause of anorexia.

The application of the pressure not only combats shock but literally some of the fluid, which is manifested as a "white bleeding" in the tissue spaces, is forced back into the circulation. Pressure applied to a burn directs counter pressure to that area. Moreover, it is believed that the pressure dressing splints the part and thereby makes the patient more comfortable and enhances healing. There is also a marked reduction in nursing efforts and total cost of materials, plasma and whole blood.

The addition of the outer layer of cellophane around the entire pressure dressing serves a definite purpose. It has been shown experimentally that outside contamination can reach a wound through the entire thickness of a dressing. Hence, the importance of interspersing a mechanical barrier, designed to protect the wound against outside invasion through the dressing itself.

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The primary objective in the treatment of malignant skin tumors is a complete cure. The surgical principles followed are: (1) wide excision of all lesions;

FIG. 1. BASAL CELL EPITHELIOMA, FOREHEAD

FIG. 2. DRAWING SHOWING WIDE EXCISION OF TUMOR, WHICH INCLUDES OUTER TABLE OF SKULL, PART OF EYEBROW, AND APPLICATION OF SPLIT THICKNESS GRAFT (A AND B). FIG. C SHOWS FLAP SHIFT TO FORM PROPER HAIR LINE ON SCALP

FIG. 3. FOUR WEEKS POST-OPERATIVELY, SPLIT THICKNESS GRAFT TO FOREHEAD

(2) closure, directly if possible, or by shifting neighboring flaps; (3) closure by skin grafting; (4) definitive reconstruction in large and highly malignant lesions, carried out six months to one year after excision, making sure there is no recur-

MALIGNANT TUMORS OF THE SKIN IN MILITARY PERSONNEL

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The importance of considering malignancies in the diagnosis of skin lesions in military personnel, regardless of age group, cannot be over emphasized. The fact that men in the Army are constantly under medical supervision makes failure to recognize and treat these lesions early inexcusable.

Most of the cases reported here had received various forms of treatment before their arrival at our hospital. The problems that these cases presented were (1) reconstruction of a defect made by excision of a tumor, (2) removal of badly pigmented and scarified skin with early malignant changes, resulting from incompetent x-ray therapy, and (3) removal of malignant tumors inadequately excised and those which had received various forms of inadquate treatment. In addition there were many lesions seen which had received no form of treatment. The entire procedure in the treatment of this last group of cases was relatively simple by comparison.

With a knowledge of plastic principles, it is possible to treat these tumors, either primary or recurrent, and obtain a complete cure of the malignancy with a minimal amount of resulting scar. To misuse valuable tissue in an attempt to repair the defect resulting from excision of extensive epitheliomata of the skin is inexcusable (fig. 35). The same is true of giving massive doses of X-ray, destroying the vascular bed and large areas of surrounding skin (fig. 36). This makes it impossible to use the neighboring skin to reconstruct the defect and necessitates the use of skin from a more distant point.

Two hundred patients with malignant tumors of the skin were seen on our plastic surgery service during a period of three years. Seventy-eight per cent of these occurred in soldiers in the second and third decades of life. The site most frequently involved was the face (ninety-two per cent). Microscopic study revealed that most of the tumors were basal cell or low grade squamous cell epitheliomata.

It is interesting that a great number of these patients were on duty in the Pacific Theater of Operations. Many presented scars of the face, the result of previous X-ray therapy. These scars had broken down and ulcerated, particularly after extensive exposure to the sunlight. It was noted that the surrounding skin frequently was keratotic. They had precancerous skin that probably would develop malignant epitheliomata by further sun exposure.

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FOREHEAD AND EYEBROW

Small lesions are easily handled by making an elliptical excision, undermining laterally, and closing in the lines of the wrinkles of the forehead. Rotation of

fig. 7

fig. 8

FIG. 7. BASAL CELL EPITHELIOMA, FOREHEAD

FIG. 8. DRAWING SHOWING EXCISION OF TUMOR AND PART OF EYEBROW, FLAP SHIFT FROM GLABELLAR REGION AND ADVANCEMENT OF ENTIRE EYEBROW MEDIALLY

FIG. 9. END RESULT TWO WEEKS POST-OPERATIVELY

neighboring flaps into a defect, effecting closure by undermining adjacent skin, can be done as shown in Fig. 8. In this case. a basal cell epithelioma involved the superior portion of the eyebrow and had been treated previously by X-ray at another installation (fig. 7). The defect was closed by using a flap taken

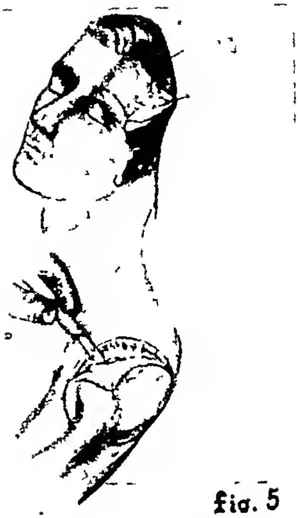


FIG. 4. HAIR-BEARING FLAP FROM SCALP SHIFTED TO FORM EYEBROW

FIG 5. DRAWING SHOWING EXCISION OF SKIN GRAFT AND TRANSFER OF TUBED PEDICLE OF THE ARM TO THE DEFECT

FIG. 6. END RESULT AFTER THE FLAP WAS DEFATTED

Figures 1 to 6 are used here by permission of Surgery Gynecology and Obstetrics.

rence; and (5) multiple excision of the defect after application of a temporary skin graft, where the defect warrants this procedure. In facial defects the use of facial skin to effect closure is the most desirable method.

skin graft taken from the opposite lid, post-auricular or supraclavicular areas. Fig. 10 represents a case of basal cell epithelioma of the upper lid, not involving the tarsal plate. Block excision was done and a full thickness skin graft was taken from the right upper eyelid to cover the defect (fig. 11). The result is shown in Fig. 12.

CHEEKS

Tumors of the cheek offer problems similar to those of other parts of the face. Where simple excision and undermining is possible, it is the desired form of treatment. When a large area of the cheek is involved, as in Fig. 13, post-auricular and neck flaps are elevated (fig. 14) and shifted to the cheek. A skin graft is applied to the area from which the flap was removed. This patient

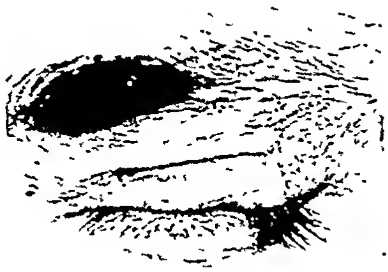


Fig. 12

FIG. 12. THREE WEEKS POST-OPERATIVELY

had multiple squamous cell epitheliomata (fig. 13). Fig. 15 shows the patient four weeks following the operation.

NOSE

Tumors involving the bridge of the nose are excised and the defects closed either by advancing wedge-shaped flaps toward each other or by full thickness skin grafts. The squamous cell epithelioma of the nose seen in Fig. 13 was treated in this manner. Fig. 15 shows the patient four weeks following this operative procedure. When the malignancy involves all of the skin of the nose and not the supporting structures, total excision of the lesion is done and a full thickness graft from the supraclavicular area is used to cover the defect.

Defects resulting from excision of lesions involving the ala can be reconstructed by using an adjacent nasolabial flap, undermining and closing the skin of the cheek where the flap was elevated. The patient shown in Fig. 16 presented a

from the glabellar region (fig. 8) and rotating it superiorly and laterally. The entire eyebrow was advanced medially as a flap.

Extremely large lesions that involve a major portion of the forehead and scalp present two problems: (1) temporary covering of the defect to allow sufficient time for certainty of elimination of recurrence, and (2) procurement of skin and subcutaneous tissue for definitive reconstruction of the resultant operative defect at a later date. The patient shown in Fig. 1 had an eroding type basal cell epithelioma involving the skin of the forehead, outer table of the skull, and the eyebrow. This patient had been operated upon twice previously and three attempts had been made to cure the lesion with X-ray irradiation. A wide excision was carried out, which included two-thirds of the eyebrow and the underlying outer table of the skull. A split thickness skin graft was applied

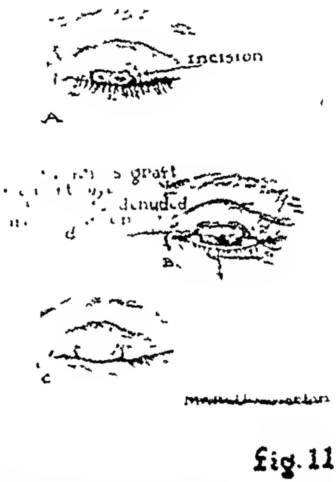


Fig. 10. Basal Cell Epithelioma, Upper Eyelid

Fig. 11 Drawing Showing Block Excision of Lesion, Full Thickness Graft Taken from Opposite Eyelid

to cover the defect (figs. 2 and 3). The eyebrow was reconstructed by shifting scalp flaps to the eyebrow area (fig. 4) and three weeks later the remaining hair-bearing skin of the scalp flap was returned to its former position. Skin and subcutaneous tissue to cover the forehead defect was obtained from a tubed pedicle flap of the arm (fig. 5). The hair line was reconstructed by a scalp flap shift and a split skin graft (fig. 2C). The end result is shown in Fig. 6, one year after the initial excision. The hair is beginning to grow back after a minor defatting procedure.

EYELIDS

In the eyelids, small malignant skin tumors which do not involve the tarsal plate offer no problem since they can be excised and covered by a full thickness

skin graft taken from the opposite lid, post-auricular or supraclavicular areas. Fig. 10 represents a case of basal cell epithelioma of the upper lid, not involving the tarsal plate. Block excision was done and a full thickness skin graft was taken from the right upper eyelid to cover the defect (fig. 11). The result is shown in Fig. 12.

CHEEKS

Tumors of the cheek offer problems similar to those of other parts of the face. Where simple excision and undermining is possible, it is the desired form of treatment. When a large area of the cheek is involved, as in Fig. 13, post-auricular and neck flaps are elevated (fig. 14) and shifted to the cheek. A skin graft is applied to the area from which the flap was removed. This patient

Fig. 12. Three Weeks Post-operatively

had multiple squamous cell epitheliomata (fig. 13). Fig. 15 shows the patient four weeks following the operation.

NOSE

Tumors involving the bridge of the nose are excised and the defects closed either by advancing wedge-shaped flaps toward each other or by full thickness skin grafts. The squamous cell epithelioma of the nose seen in Fig. 13 was treated in this manner. Fig. 15 shows the patient four weeks following this operative procedure. When the malignancy involves all of the skin of the nose and not the supporting structures, total excision of the lesion is done and a full thickness graft from the supraclavicular area is used to cover the defect.

Defects resulting from excision of lesions involving the ala can be reconstructed by using an adjacent nasolabial flap, undermining and closing the skin of the cheek where the flap was elevated. The patient shown in Fig. 16 presented a

squamous cell epithelioma. The tumor was excised, a nasal flap rotated to cover the defect, and a nasolabial flap was used to fill the defect left by the elevation

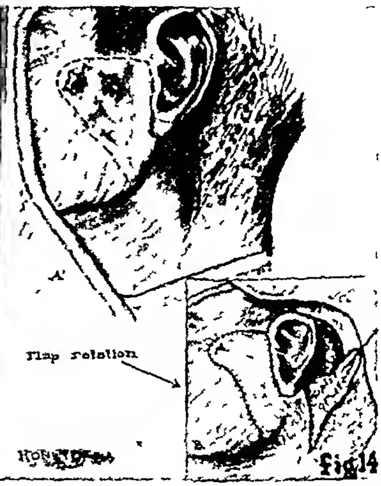


FIG. 13. MULTIPLE SQUAMOUS CELL EPITHELIOMATA, NOSE AND CHEEK

FIG. 14. DRAWING SHOWING EXCISION OF TUMORS; LARGE FLAP TAKEN FROM POST-AURICULAR AREA AND NECK AND SHIFTED TO DEFECT; SPLIT THICKNESS GRAFT TO POST-AURICULAR AREA LESION OF THE NOSE WAS EXCISED AND CLOSED BY ADVANCING TWO WEDGES

FIG. 15. THREE WEEKS POST-OPERATIVELY

of the nasal flap (fig. 17). The end result is shown in Fig. 18. two weeks post-operatively. A defect formed by excision of a tumor of the tip of the nose is

reconstructed by shifting a visor flap from the bridge of the nose downward and applying a full thickness skin graft to the area from which the flap was taken, in

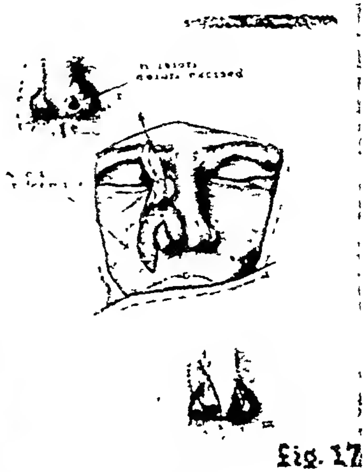


FIG. 16. SQUAMOUS CELL EPITHELIOMA, ALA NASI

FIG. 17. DRAWING SHOWING EXCISION OF TUMOR; FLAP SHIFT FROM OPPOSITE SIDE OF NOSE; NASOLABIAL FLAP ELEVATED TO AREA WHERE NOSE FLAP WAS TAKEN

FIG. 18. THREE WEEKS POST-OPERATIVELY

order to maintain nasal tip contour. The more extensive lesions, involving the entire nose, may be reconstructed with forehead flaps or neck tubes.

squamous cell epithelioma. The tumor was excised, a nasal flap rotated to cover the defect, and a nasolabial flap was used to fill the defect left by the elevation

FIG. 13. MULTIPLE SQUAMOUS CELL EPITHELIOMATA, NOSE AND CHEEK

FIG. 14. DRAWING SHOWING EXCISION OF TUMORS; LARGE FLAP TAKEN FROM POST-AURICULAR AREA AND NECK AND SHIFTED TO DEFECT; SPLIT THICKNESS GRAFT TO POST-AURICULAR AREA. LESION OF THE NOSE WAS EXCISED AND CLOSED BY ADVANCING TWO WEDGES

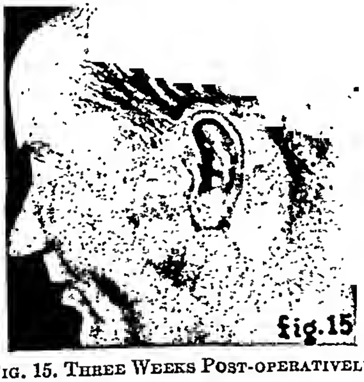


FIG. 15. THREE WEEKS POST-OPERATIVELY

of the nasal flap (fig. 17). The end result is shown in Fig. 18, two weeks post-operatively. A defect formed by excision of a tumor of the tip of the nose is

mucosal tissue of the lip, undermining buccal mucous membrane, advancing it up and out, attaching it to outer skin, and forming a new vermilion border. This procedure was done on the patient in Figs. 25, 26 and 27, for treatment of superficial squamous cell epithelioma of the lower lip.

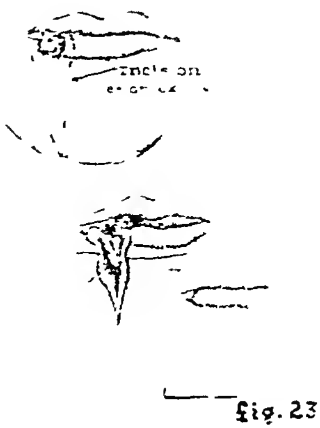
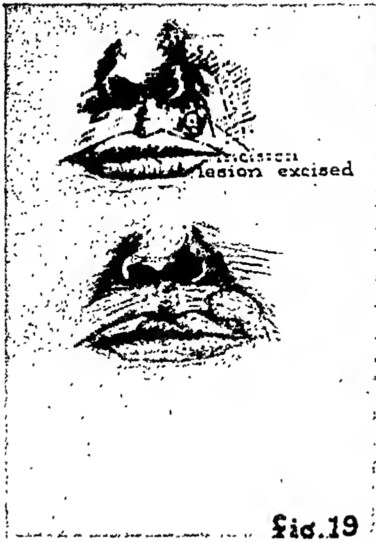


FIG. 22 SQUAMOUS CELL EPITHELIOMA, LOWER LIP
FIG. 23. DRAWING SHOWING "V" EXCISION OF LESION AND CLOSURE

FIG 24 EIGHT WEEKS POST-OPERATIVELY

Localized lesions of the lip are excised in the form of "V"-shaped wedges, which comprise the full thickness of the lip, including buccal mucous membrane (figs. 22, 23 and 24). A large portion of the lip can be removed in this manner and closed, even up to two-thirds of its length. Later on the deformity can be corrected by the Abbe or the Estlander operation, taking tissue as a pedicle from the opposite lip.



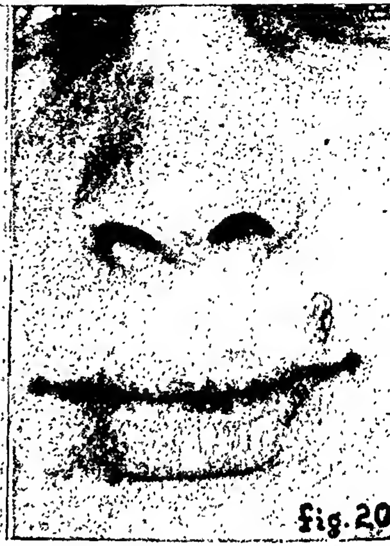


FIG. 19. BASAL CELL EPITHELIOMA, UPPER LIP

FIG. 20. DRAWING SHOWING EXCISION OF THE TUMOR; SHIFTING OF NASOLABIAL FLAP INTO THE DEFECT

FIG. 21. FOUR WEEKS POST-OPERATIVELY

LIPS

Precancerous lesions or leukoplakia involving the entire mucous membrane of the lips are treated by "lip shave". This consists of excising mucosal and sub-

(figs. 19 and 21). Upon arrival at our hospital, the patient shown in Figs. 31 and 32 had a large squamous cell epithelioma involving the entire lower lip. Enlarged lymph glands of the neck were present. A wide excision of the entire

FIG. 28 LEUKOPLAKIA, BUCCAL MUCOUS MEMBRANE
FIG. 29. DRAWING SHOWING ARROW EXCISION AND CLOSURE

FIG 30 FOUR WEEKS POST-OPERATIVELY

lower lip was performed and carried down to the mandible. A split thickness graft was applied to the defect. A bilateral neck dissection was also done. Definitive reconstruction will be done at a later date.

When the tumors are rather extensive and involve a large portion of the lip, a more major procedure is indicated. The defect should not be corrected following excision until an interval of six months to a year has elapsed to make sure

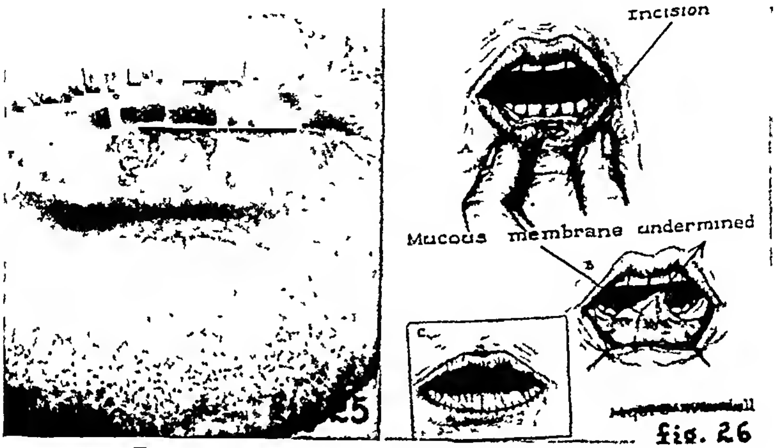


FIG 25 SQUAMOUS CELL EPITHELIOMA, LOWER LIP

FIG. 26 FULL THICKNESS EXCISION, MUCOUS MEMBRANE, LOWER LIP, WITH ADVANCEMENT OF BUCCAL MUCOUS MEMBRANE, AND CLOSURE ("LIP SHAVE")

FIG 27. SIX WEEKS POST-OPERATIVELY

that there is no recurrence The defect can be treated then by a neck tube, a visor flap from the neck, or bilateral nasolabial flaps.

The tumor of the upper lip shown in Fig 20, a basal cell epithelioma, had been treated previously at another installation by incomplete excision and grafting. At our hospital it was excised and a nasolabial flap was rotated into the defect

part excised should be carried out after an interval has elapsed to make sure there is no recurrence. The ear can be reconstructed by insertion of cartilage

FIG. 34. FULL THICKNESS EXCISION OF TUMOR TISSUE, INVOLVING CARTILAGE OF NOSE
FIG. 35. FISTULA INTO MOUTH, RESULT OF IMPROPER HANDLING OF SKIN FLAPS TO TREAT A LESION OF THE LOWER LIP. NECK TUBE FORMED FOR RECONSTRUCTION

FIG. 36. RADIATION SCARRING OF FACE, WITH SECONDARY MALIGNANT CHANGES

in the post-auricular area, with elevation of it at a later date and application of a split thickness graft in the post-auricular area and the posterior surface of the newly formed ear.

EAR

Small skin tumors in the post-auricular area are treated by excision and direct closure. Larger tumors are excised and split thickness grafts are applied. Small

Fig. 31. Squamous Cell Epithelioma, Lower Lip

Fig. 32. Wide Excision of Lesion and Split Thickness Graft over the Mandible

Fig 33 Squamous Cell Epithelioma, Nose

tumors involving the ear proper are treated by "V" excision and direct closure, making a smaller ear. If the helix is involved, it may be reconstructed by the use of post-auricular flaps In large lesions of the ear, reconstruction of the

THE COMBINED USE OF MULTIPLE EXCISION, THE Z-PLASTIC AND SLIDING FLAPS IN THE CORRECTION OF CERTAIN CONGENITAL AND ACQUIRED ANOMALIES*

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AND

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It is not the purpose of this paper to advance any new or original procedures for the treatment of various types of either acquired or congenital anomalies, but rather to emphasize the usefulness of the "Z" plastic, multiple excision and sliding flap when employed in combination in their correction.

My interest in these methods dates back to 1925 when I first became associated with my former Chief, Doctor Ferris Smith of Grand Rapids, Michigan. Since that time their usefulness has become increasingly apparent to me until I now give them first consideration in all contractures and large skin defects whatever their etiology. We are all aware that these methods of necessity require more operative stages, but that the final result more than justifies the time spent on the part of both the patient and the surgeon. There are instances, however, when surface defects such as large hairy pigmented nevi must be excised in toto and the defect covered by a skin graft. At a later date this graft, if unsightly, may then be removed by multiple excision and any residual removable portion replaced by a full thickness graft the color of which more nearly approximates that of the region involved. In old burn scar contractures one frequently finds it advantageous to use the cicatricial tissue for his original flaps and later remove it by multiple excision. In any event all of these problems require a definite preoperative plan which is aided by drawings of the various steps to be used. There will of course be changes in the best laid plans which will have to be made at the time of operation, but there must be a single aim in all to assure that each procedure brings you nearer to the desired end result. One should also bear in mind that incisions into neighboring normal skin should not be made if at all avoidable. The old adage "never increase a scar deformity" is as true today as ever. Ample time between steps is one's greatest ally, for time alone will produce the softening and relaxation of tissues necessary to accomplish the desired result.

The following cases are presented to demonstrate the utilization of the procedures under discussion. Unfortunately some of them are incomplete.

Case No. 1. Figures 1 and 2 demonstrate the resultant contracture involving the chin, anterior neck and upper thorax of a girl who had previously suffered a third degree burn. Figures 3, 4 and 5 show the relaxation obtained and the improvement in the neck line following the initial "Z" plastic operation. Figures 6 and 7 reveal the present status of the

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MOUTH

A very frequent lesion found in the mouth is leukoplakia. The patient shown in Fig. 28 presented a lesion involving the buccal surface of the cheek. The involved mucous membrane was excised completely, the neighboring mucous membrane was undermined and the wound was closed in the form of an arrow incision (figs. 29 and 30).

SUMMARY

There are several points which are worth emphasizing: (1) Early recognition of malignant tumors in military personnel is important. Even though we are constantly dealing with injuries of the battle-casualty type, we must not overlook the possibility that chronic ulcers are neoplastic until proven otherwise. (2) Most of these cases of malignancy can and should be treated surgically. No tumor should be irradiated until the type of tumor has been determined. A large percentage of the epitheliomata of the skin could have complete removal at the time of biopsy. In many instances, excision biopsy can be accomplished, using the plastic procedures described, which will result in a cure of the tumor with a minimal amount of residual scar. (3) Knowledge of pathology is indispensable in the treatment of any malignancy. This eliminates the inadequate excision of malignant tumors and the necessity of further complicated reconstructive surgery. (4) It is essential that the principles of general plastic and reconstructive surgery be followed for the successful treatment of malignant skin tumors.

Figs. 31–36 represent unforgivable errors in the treatment of malignancies. Figs. 31 and 32: Multiple biopsies and finally incomplete removal by cautery, necessitating surgical removal of the lip and chin, with a questionable cure of the malignancy (fig. 32). Figs 33 and 34: An unrecognized epithelioma treated with ointments. As a result, reconstruction of the left side of the nose was eventually necessary. Fig. 35: A lack of knowledge of plastic surgery principles was the cause of destruction of valuable tissue and resultant unsightly deformity in this case. Fig. 36: An example of an X-ray dermatitis, following irradiation of a mole.

factory chin and neck line, the residual scaring, if not too obvious, can be successfully camouflaged by the use of a heavy powder and thereby save her several stage operations.

FIG. 5

FIG. 6

FIG. 7

FIG. 8

Case No. 3. This patient sustained a third degree burn along the right side of her neck and over her anterior thorax which on healing resulted in the contracture noted in the preoperative photographs shown in Figures 15 and 16. Figures 17 and 18 show the result three

case following partial excision of the scar tissue about the neck and chin. She will require further surgery employing both of the above procedures before the desired effect is obtained.

Case No. 2. The pre-operative views are shown in Figures 8 and 9 and demonstrate a contracture of the anterior cervical region again the result of a burn. Figure 10 shows the

FIG. 1

FIG. 2

FIG. 3

FIG. 4

patient the third day following a "Z" plastic for the release of the contracture and figures 11 and 12 her appearance 4 months later. Multiple excision was then resorted to and figures 13 and 14 show the final result obtained. These last photographs were taken with the patient wearing cosmetics and purposely so to demonstrate that, after obtaining a satis-

chin and neck line. This patient was seen recently after an interval of five years and it was quite satisfying to note the minor deformity still present which requires surgical correction.

Fig. 13

Fig. 14

Fig. 15

Fig. 16

Case No. 4. This man suffered burns about the left face which resulted in the contracture and disfigurement noted in figure 22. The result shown in figure 23 was accomplished by employing "Z" plastics, multiple excision and the temporary use of a split skin graft. As

days following a one stage procedure in which excision, "Z" plastic relaxation and sliding flaps of neighboring normal skin and subcutaneous tissue were employed to accomplish

FIG. 9

FIG. 10

FIG. 11

FIG. 12

release of the contractures. In the photographs shown in figures 19, 20 and 21 taken one month post operatively, the small amount of scar remaining along the right side of the face and neck is evident as is the degree of relaxation of the contracture and the relatively normal

of severe burns about the right axillary region, abdomen and inguinal areas. The latter contracture apron completely hid the genitalia and caused him much mental anguish.

FIG. 21

FIG. 22

FIG. 23

FIG. 24

Figure 26 taken two months post-operatively reveals what was accomplished following a double "Z" plastic procedure employing the cicatricial tissue of the contracture itself.

will be noted a portion of the graft placed over the right cheek as a temporary covering remains but could be removed if the patient so desired.

FIG 17

FIG. 18

FIG. 19

FIG. 20

Case No. 5. As previously mentioned in this paper scar tissue can be used to good advantage in the correction of old burn contractures. Figures 24 and 25 present an interesting problem in this respect. As you will note he has developed multiple contractures the result

Their care is shown to illustrate the large amount of skin of the face which can be removed when done gradually, without resultant distortion of either the eye lid or mouth

Fig 29

Fig. 30

Fig 31

Fig 32

Case No 7 This case, as shown in pre operative figures 29, 30 and 31 is a good example of what multiple excision accomplishes in patients with large hemangiomas of the face On first consideration one might feel that excision followed by a skin graft would be the best

The shaft of the penis at its base will have to be released at a later date and the abdominal and axillary contractures will have to be corrected.

FIG. 25

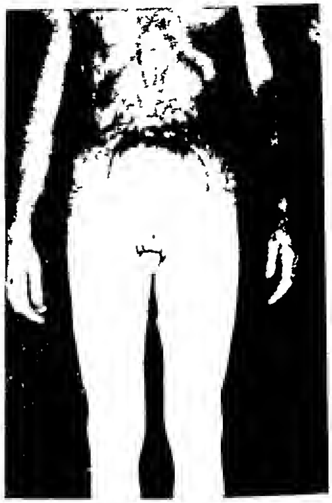

FIG. 26

FIG. 27

FIG. 28

Case No. 6. Figure 27 demonstrates another condition, namely Pigmented Nevi, which are most satisfactorily cared for by multiple excision and "*Z*" plastics. Figure 28 shows the result obtained following the procedure of multiple excision which is not yet completed.

Their care is shown to illustrate the large amount of skin of the face which can be removed when done gradually, without resultant distortion of either the eye lid or mouth.

FIG 29

FIG. 30

FIG. 31

FIG. 32

Case No. 7. This case, as shown in pre-operative figures 29, 30 and 31 is a good example of what multiple excision accomplishes in patients with large hemangiomas of the face On first consideration one might feel that excision followed by a skin graft would be the best

solution and indeed it would be the quickest. However, figures 32, 33, 34 and 35 demonstrate a cosmetic result obtained by multiple excision which we feel is superior to that which

Fig. 33

Fig. 34

Fig. 35

one would have gotten by employing a skin graft. Further minor excisions of the left cheek scar and adjustment of the left angle of the mouth are indicated and will be done in the near

future. Note the minimal distortion of the left lower lid, cheek, left ala and left angle of the mouth.

This paper is humbly presented in the hope that it will further stimulate the use of these old and proven, but often overlooked, procedures in the correction of certain acquired and congenital anomalies.

MICROGNATHIA. TREATMENT WITH EXTERNAL PROSTHESIS[1]

HECTOR MARINO, M.D. AND MARIO CRAVIOTTO, O.D.

Buenos Aires, Argentina

The deficiency of development of the lower jaw is not seen very often among the diseases of this bone. But there is a certain number of patients who are affected by this deformity due to congenital or traumatic causes, to ankylosis or infection of the maxilla. There is an abnormal appearance (bird face) and there may be nutritional trouble, as the patients do not masticate correctly, because of bad occlusion and difficulty in opening the mouth.

In spite of the seriousness of the deformity, until now the surgeons have shown little enthusiasm in indicating an operation because there were many dangers and difficulties for those who tried to perform the correction of returning the bone to normal size. Therefore it is easy to understand why the methods with purely aesthetic aims became popular, only seeking the correction of the profile while the maxillary function was not taken into consideration. Thus fairly good results were obtained filling the defect with permanent intraoral prosthesis or with grafts or inclusions by extraoral methods.

The characteristics of each case indicated the method but, even if the aspect became quite satisfactory, the surgeon could not always agree with the result, because the ideal reconstruction must involve also the altered function.

Until now all the procedures were based on the section of the horizontal ramus of the maxilla, because the operations on the vertical ramus do not give enough length, as the lengthening must be so great that the ends will hardly meet, making their union difficult or impossible.

This displacement in operations on the horizontal ramus leads to the use of different methods to obtain a solid union. There are ladder sections (von Eiselberg and Pehr) and sections in L-shape (Kazanjian). But sometimes even this is not enough, because the scant guarantee offered by the small area of contact of both fragments almost obliges the use of bone grafts in order to obtain a solid union. This involves all the problems that derive from grafting in a septic medium, as the lengthening of the maxilla makes it necessary to open the buccal mucosa, therefore there is a direct contamination by saliva. For this reason many authors advocate the use of a previous costal graft (Limberg and Axhausen). After a period of revitalization this graft is inserted between the separated fragments and the procedure can be carried through with no setbacks, as the living bone is better able to withstand the infection.

But there are still more difficulties. If a good union is wanted the fragment should be perfectly immobilized, which is not always possible with ordinary procedures (interdental ligatures, crowns and bars). The teeth of these patients are of little help in the prosthetic work, as they are always weak due to their bad

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function and carious due to poor general condition. Finally, even if a good immobilization can be obtained, one often has to operate with narcosis and there are always postanesthetic complications as the patient remains with the mouth closed and the aspiration of vomitus or blood may give rise to respiratory trouble and even death.

Appliances which fix the fragment with a clamp on the symphysis (*v. Bruhn*) are exposed to the same criticism: they bring postanesthetic complications and hinder correct feeding.

Briefly, all the methods employed until now to correct surgically the deficiency of development of the lower jaw, are subjected to the following basic defects: (1) the oral infection does not allow immediate cortical bone grafting; (2) the intraoral immobilization of the fragments depends on dental conditions. Extra-oral immobilization with von Bruhn's appliance is neither reliable nor adequate; (3) intraoral immobilization is a danger for the postanesthetic period.

We have planned the following operative scheme to solve these troubles, which we consider able to give successful results: (A) *Examination and preparation of the patient.* The odontologist specialized in prosthesis takes an impression of both dental arches—which is not always easy—to ascertain the possibilities of the case and the required extent of the displacement. Bars are fixed to the dental arches to allow postoperative immobilization with interdental wiring. A complete clinical study of the patient is performed to avoid postoperative complications. Penicillin in average doses is administered preoperatively. (B) *Anesthesia.* We prefer intratracheal narcosis (ether-oxygen) with local infiltration of novo-adrenalin. Narcosis should be preferred as most of the patients are children or adolescents in whom it is difficult to operate under local anesthesia; beside it is imperative to have complete muscular relaxation and further the intratracheal technique can guarantee against blood slipping into the respiratory tract. Local infiltration with novo-adrenalin lessens the blood loss and the amount of general anesthetic used. (C) *Obtention of cancellous bone to fill the defect.* It is taken from the illium, in a previous aseptic stage. The bone thus obtained is specially favourable as to regeneration and resistance to infection. (D) *Application of the extraoral prosthesis.* It is in a way the clue to the method: the surgeon has to have ready two sets of bars and joints, each provided with its corresponding pins, as employed to treat maxillary fractures with Mowlem's method. We have used with success the appliances modified by Alessandrini (Chile). Once the pins are fixed on both horizontal rami, the bars and joints are applied and the anterior fragment can be perfectly immobilized, without restraining the free movement of the maxilla in the postoperative period. (E) *Section of the maxilla.* On both sides a deep incision is made on the lower edge of the jaw. The facial artery is clamped, ligated and cut, and the periosteum is elevated, exposing the cortical surface. The oral mucosa is cut in front of the section of the bone. The bone section is made with an electric burr and the hemostasis performed with Horsley's wax (figs. 1, 2 and 3). (F) *Displacement of the anterior fragment.* Once the section of both branches is finished the maxillary arch becomes free and it can be moved forward as much

as necessary. The displacement is facilitated by cutting and dissecting the oral mucosa; the communication with the oral cavity is large, but it has no

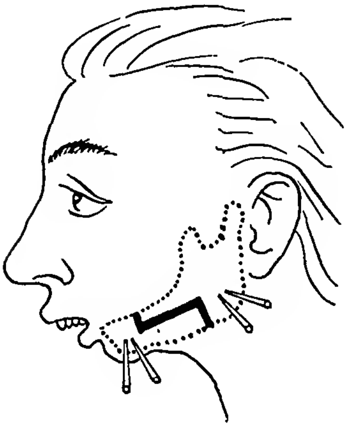


Fig. 1

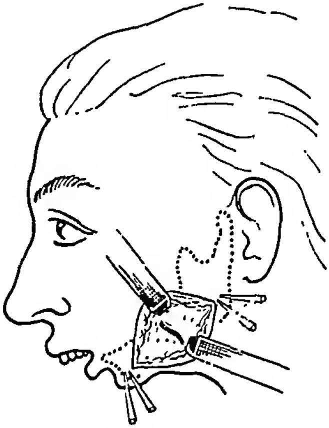


Fig. 2

Fig. 1. Tracing of the Section of the Jaw
Fig. 2. Cutaneous Incision. The Prosthetic Appliance has not been Drawn to Show More Clearly the Operation

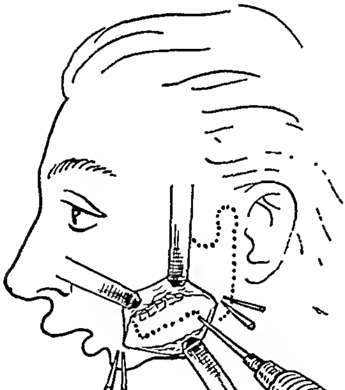


Fig. 3

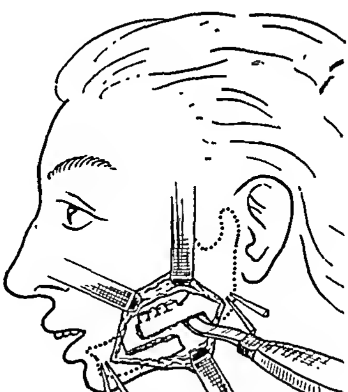
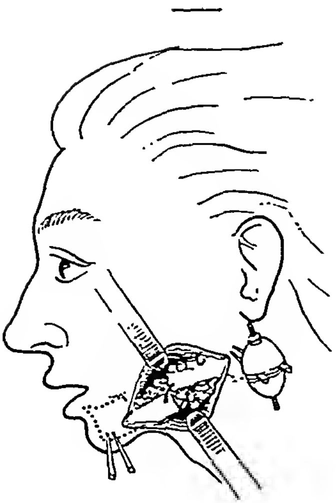


Fig. 4

Fig. 3. Cutting the Bone with a Dental Burr
Fig. 4. The Anterior Arch Slides Forward. The Periosteum is Elevated to Mobilize the Soft Tissues

major importance. The bars of the extraoral prosthesis are the guides to get a precise forward displacement as shown by the previous study, and fixation in the definite position is immediately obtained by tightening the screws of the appli-



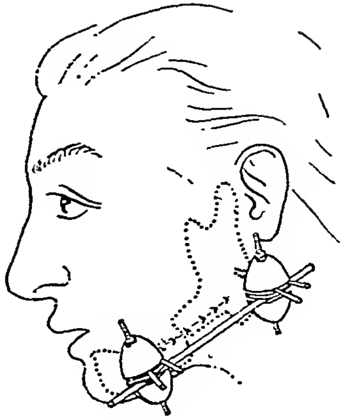


FIG. 5 FIG. 6

FIG. 5. FILLING THE DEFECT WITH CANCELLOUS BONE CHIPS
FIG. 6. SHOWING THE END OF THE OPERATION WITH THE EXTRAORAL APPLIANCE

FIG. 7 FIG. 8

FIGS. 7 AND 8. MICROGNATHIA IN AN 11 YEARS OLD GIRL DUE TO BILATERAL ANKYLOSIS OF THE TEMPORO-MANDIBULAR JOINT. THE ANKYLOSIS HAS BEEN SUCCESSFULLY OPERATED

ances (fig. 4). (G) *Placing of the bone-grafts.* As the ends of the maxillary fragments seldom meet precisely, a good consolidation is sought by filling the defect with cancellous bone chips (fig. 5). (H) *End of the operation.* The skin

as necessary. The displacement is facilitated by cutting and dissecting the oral mucosa; the communication with the oral cavity is large, but it has no

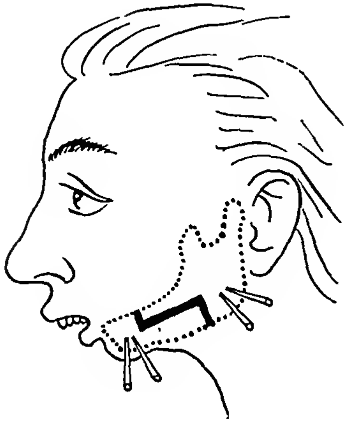
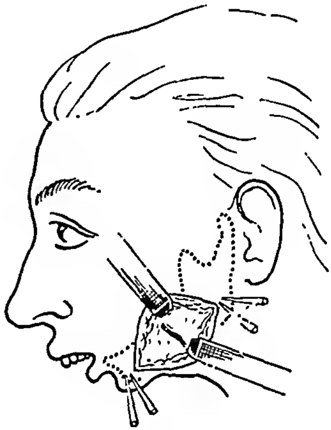


Fig. 1



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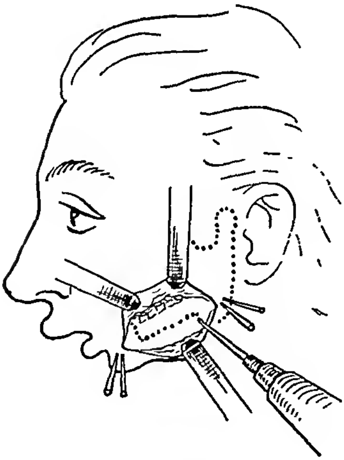

Fig. 3

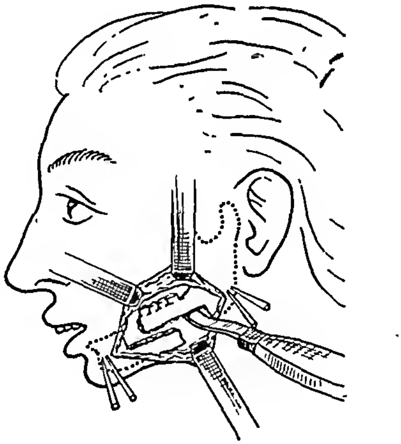

Fig. 4

Fig. 3. Cutting the Bone with a Dental Burr

Fig. 4. The Anterior Arch Slides Forward. The Periosteum is Elevated to Mobilize the Soft Tissues

major importance. The bars of the extraoral prosthesis are the guides to get a precise forward displacement as shown by the previous study, and fixation in the definite position is immediately obtained by tightening the screws of the appli-

Speech is not influenced. Buccal sepsis is lessened as there is no closed cavity and as nutrition becomes soon normal. Late complications are seldom seen.

Penicillin is prescribed by parenteral and oral routes to lessen the danger of inflammation and suppuration.

Once a prudential time has passed, and if the patient is in a good condition, the orthodontist can take full advantage of an interdental immobilization, with wiring or elastic traction. As soon as the consolidation is reached, the extraoral prosthesis are taken off and the orthodontic treatment is continued as long as necessary. The cancellous bone grafts help to obtain a quick consolidation of the jaw, but it is wise to maintain immobilization at least 40 days.

FIG. 13. POSTOPERATIVE X-RAY OF THE PATIENT

The technique above described was applied for the first time on the case illustrated here and fulfilled the authors' expectations (figs. 7 to 13).

Summary. The authors propose the following surgical treatment for micrognathia: (a) application of an extraoral prosthesis; (b) ladder section of the bone; (c) immediate grafting with cancellous bone chips. They believe that, in this way, it is possible to avoid many of the troubles observed with other techniques and get a carefree postoperative period.

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is sutured in two layers and a small drainage is put through a stab incision. A running catgut suture closes the mucosal incision easily (fig. 6).

Fig. 9

Fig. 10

Figs. 9 and 10. Patient in Postoperative Period with Extraoral Prosthesis

Fig. 11

Fig. 12

Figs. 11 and 12. Showing End Result after Lengthening of the Maxilla

Postoperative period. The immediate postoperative period is facilitated as the patient is able to vomit freely and fluids and soft food are allowed early.

SPEECH DISORDERS IN WORLD WAR II

X. Speech Defects Resulting from Maxillofacial Injuries

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Syracuse, N. Y.

The various phases of surgical management and incidence of maxillofacial wounds during World War II have been emphasized repeatedly in the recent literature. The final rehabilitation of these casualties in relation to residual speech defects at the conclusion of all specific reconstructive surgery in the zone of the interior has received but scant attention. Two previous papers in this respect have appeared from this clinic. The first (3) outlined the routine methods of examination for cases of this type. The second (4) included a survey of the incidence and treatment of speech disorders resulting from maxillofacial injuries as observed at the nine specially designated army general hospitals for plastic surgery. It was felt that there were few instances of residual articulatory disturbances necessitating therapy following corrective surgical procedures.

The speech clinic has been attached to the neurosurgical service throughout (Brooke, McGuire and Valley Forge General Hospitals) being organized on May 7, 1943. Previous material included patients primarily with accompanying neurological implications. As Valley Forge General Hospital is an associated plastic surgery center it has been possible to make a more detailed study of the various articulatory problems incidental to maxillofacial casualties. This has been an opportune period for such an investigation even though the maximum patient load seen during active warfare has long since past. This is because the more extensive wounds which are more likely to present associated articulatory defects are just completing prolonged surgical procedures making the time ideal for such speech therapy as may be indicated. This paper, therefore, includes further data on the incidence and re-education of this type of case.

The type of speech defects observed depended upon the location and severity of the pathology. The majority of our cases were traumatic as will be demonstrated later. Wounds were commonly multiple and often extensive resulting in both articulatory and vocal problems (neurological and/or structural). Before proceeding to the various injuries associated with speech disorders, a definition of the terms usually applied to these conditions is necessary.

DEFINITION OF TERMS

Dyslalia is the term employed to denote a disorder of articulation on a structural rather than a neurological basis. It may be organic due to actual disease, inflammation, deformity or injury to the organs of articulation such as congenital cleft lip and palate, tumors, gunshot wounds of the tongue, lips, soft and hard palates, etc.; or it may be functional in such conditions as low educational standards, e.g. sigmatism (lisping), regional differences (southern, New England

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Where several co-existing disorders were present as was so often the case, it was placed in the group of the most apparent impairment on examination.

Table 1 includes the various etiological factors encountered during this study. For the sake of completeness, both organic and functional cases treated in the clinic have been tabulated. The maxillofacial wounds were subdivided

TABLE 1—*Cases of Dyslalia from May 7, 1943 to August 1, 1946*

1 Maxillo-facial Injuries	
a Maxilla	59
Associated wounds	
1. mandible	20
2. zygoma	18
3. hard palate	16
4 peripheral vii	8
5 lips	7
6. tongue	6
7 trismus	5
8 floor mouth	3
9. peripheral xii	3
10 peripheral ix-xii	2
b Mandible	53
Associated wounds	
1 lips	26
2 tongue	18
3 floor mouth	16
4 maxilla	6
5 peripheral vii	4
6 trismus	4
7 hard palate	3
8 zygoma	2
9 laryngeal cart	2
10 peripheral xii	2
11 peripheral x	1
2 Sigmatism	16
3. Acromegaly	5
4 Cleft palate	4
5 Tumors	
a. tongue	1
b hard palate	1
6 Soft palate, traumatic	1
7 Burns	1
8 Myasthenia gravis	1

into two large groups, the main damage being either to the maxilla or mandible. Associated injuries to the facial region were mentioned for additional clarity. It is to be pointed out further that the majority of these patients sustained multiple wounds elsewhere as well This not only included the extremities and visceral cavities, but also the many vital structures of the head and neck regions, e g . cranio-cerebral and spinal cord traumata, bilateral loss of vision, etc.

etc.), foreign dialects, etc. Dyslalia must be sharply differentiated from dysarthria which connotes articulatory problems arising from a lesion of the central or peripheral nervous systems. An individual case may present both structural and neurological disabilities which of course accentuates the speech problem.

Dysphonia implies impairment of voice commonly due to conditions affecting the laryngeal mechanism. They may be organic including traumata, infections, congenital abnormalities, tumors, etc., or functional such as poor vocal habits, aphonia on the basis of a conversion hysteria, etc. Phonatory problems, incidence and management have been discussed recently (6), and it was pointed out that an adequate description of the voice should include mention of pitch, quality (tone), intensity (including inflection) and rate. This is important as many patients with maxillofacial wounds also have associated changes in voice. The latter may be due to structural or neurological lesions of the larynx particularly in relation to pitch and quality which are largely properties of vocal cord action. However, these characteristics may be disturbed concerning amplitude and resonation by changes in the oral outlet (pharynx, mouth and nose). Factors of intensity and rate are much more apt to be altered in the presence of facial and intra-oral injuries. In these cases, therefore, the over-all problem must be considered, i.e., to determine the speech problem present; whether articulatory and/or vocal, and then, if it is structural and/or neurological in origin.

TYPES OF INJURY

The majority of maxillofacial wounds that resulted in speech involvement were due to structural rather than neurological damage to the articulatory mechanism although associated injuries were not uncommon. Trauma to the following anatomical structures most frequently resulted in speech disturbances. Dyslalia was the usual defect unless otherwise stated.

1. Soft tissues, particularly the lips and cheeks.
2. Loss of varying portions of the tongue.
3. Wounds of the floor of the mouth with late cicatricial contractures, commonly involving the tongue.
4. Maxillary fractures with concomitant soft tissue injury.
5. Mandibular fractures and deformities.
6. Loss of teeth, particularly the incisors.
7. Trismus.
8. Cranial Nerve injuries: a. Facial, hypoglossal (peripheral)—dysarthria. b. Vagus, recurrent laryngeal—dysphonia.
9. Tracheotomized patients (dysphonia) with maxillofacial wounds (dyslalia).
10. Structural damage to the larynx: a. incomplete—dysphonia. b. complete—aphonia.
11. Perforation of hard and soft palates (rhino-phono-lalia).

Six hundred twenty-five cases have been observed with speech defects at this clinic through August 1, 1946. One hundred forty-two, or 23%, were classified as dyslalia, 81% of which were due to wounds or exposure to enemy action.

that there are no residual changes in voice. Clark (1) reported eight tracheotomies in a series of 150 casualties but no ill effects were mentioned. Clarkson (2) stated that only one complication resulted in 27 intubations from a study of 1000 maxillofacial injuries. Erosion of the innominate by a low cannula was recorded. Vocal changes have not been always specifically covered or fully investigated. For an adequate history in a case of this type, one cannot rely on a single negative reply on the part of the patient when asked if there have been any alterations in his voice. All vocal characteristics including quality, intensity, rate and pitch must be mentioned for accurate results as previously recorded (6). We have had the opportunity recently of examining 42 patients from these standpoints following wounds of the face and neck with associated tracheotomy. The results of this study have been presented statistically in table 2. Unfortunately, it was not possible to perform a vocal analysis in any of these patients prior to injury for obvious reasons. The dysphonia in some of these cases, therefore, could be due to faulty vocal habits.

TABLE 2

1. Pitch—lower than normal—26
   higher than normal—5
2. Quality—slightly hoarse or husky—27
3. Intensity—weak—39—six of which had this symptom alone.
   Only slight changes in inflection were noted.
4. Rate—reduction—11
5. No change—1

A laryngeal examination was performed in every instance unless obviated by extreme facial deformity with reduction in size of the oro-pharynx and limitation of mandibular motion. With the exception of one case that showed fixation of the arytenoid cartilages, and one man with a densely adherent superficial scar over the thyroid and cricoid cartilages with the possibility of laryngeal distortion, the findings were negative throughout. It is conceivable, of course, that intrinsic cord changes were present in some of these patients and that actual pathology existed in those in which the cords could not be examined for the above reasons. However, enough material is available in identical cases (maxillofacial traumata without tracheotomy) to assume that dysphonia may be present even on the basis of negative laryngoscopy (see number 5 below). There are several possible explanations for these findings:

1. High Tracheotomy. One case presented separation of the cricoid cartilage and cricothyroid membrane.

2. Prolonged wearing of the cannula; improper size, shape and material. Several examples have been studied in this category. Minor vocal alterations have been noted following as few as three days of intubation. The average time of insertion has been two to three weeks, but cases up to three months and longer have not been unusual.

3. Poor post-operative management with neglect of daily care and changing. Such is possible due to the exigencies of modern warfare.

We have not included the articulatory disorders due to poor speech habits other than those characterized by sigmatism (lisping). Ten of the latter group were in action with no change in their symptomatology. Problems arising from foreign dialects and other functional conditions also were deleted from our records due to their frequency in association with limited trained personnel available during a period of active warfare. Such disturbances were not disabling or disqualifying and it was only fair to devote rehabilitation measures to those with organic etiological factors. Defects with Spanish were particularly common while at Ft. Sam Houston due to induction of men of Mexican extraction in this area. The treatment of acromegaly and myasthenia gravis was primarily medical and that of carcinoma of the hard palate, surgical (with deep x-ray therapy) due to the progressive nature of these lesions. The case with the lingual hemagioma achieved good articulatory compensation after operative removal. The four cases of cleft palate with associated cleft lip were congenital, speech re-education resulting in improvement following surgical correction of the deformities. Although many burn cases were observed while at Valley Forge General Hospital, only one patient with extensive cicatricial contractures of the lips, tongue and floor of the mouth was included in this series. Speech therapy resulted in achieving adequate compensation of the articulatory impairment.

All wounds had been debrided primarily in the theaters of operation; secondary plastic surgery being continued as indicated during the late reconstructive period in the zone of the interior. The subsequent speech problem was considerably ameliorated by corrective procedures involving the various parts of the articulatory apparatus (lips, teeth, alveolar ridges, hard and soft palates, and tongue). Injuries to the hard palate most commonly implicated the palatine process of the maxilla unilaterally and only occasionally, the horizontal part of the palate bone. Closure was completed successfully in all traumatic perforations (11 instances). Wounds of the soft palate were rarely seen alone. Practically all injuries of the lips needed some form of plastic revision. Seven cases with adhesions between the tongue and the floor of the mouth were operated upon with increased lingual mobility. Patients of this type must be carefully selected as new scar formation is difficult to obviate in all instances. However, in successful cases, the subsequent speech problem is considerably facilitated as typified in this series. Mandibular wounds most commonly showed associated trauma to the tongue and floor of the mouth. Further, most of these casualties had considerable loss of teeth necessitating some form of dental support by the oral surgeon. Although a certain amount of trismus was present early in most cases, it was a factor for additional care in only five maxillary and four mandibular injuries.

VOCAL CHANGES FOLLOWING TRACHEOTOMY

The indications for tracheotomy in war wounds of the face and jaws are well known. When correctly placed, with adequate post-operative care and in the absence of actual damage to the laryngeal cartilages it has been felt generally

FIG. 1. LOSS OF PORTION OF THE RIGHT ANTERIOR ⅔ OF THE TONGUE WITH CONSIDERABLE CICATRICIAL CONTRACTURE BETWEEN THIS PART OF THE TONGUE AND FLOOR OF THE MOUTH

FIG. 2. INABILITY TO PROTRUDE THE TONGUE DUE TO INTRINSIC DAMAGE TOGETHER WITH ADHESIONS BETWEEN THE POSTERIOR ⅓ OF THE TONGUE AND THE ORO-PHARYNX

4. Associated maxillofacial deformity with distortion of the oral outlet.

5. Changes in voice in relation to intensity and rate can well be explained on the associated facial wound, distortion and variations in the oro-pharynx. Although pitch and quality are properties of adequate laryngeal function, they are subject to further amplification and resonation dependent on the integrity of the remainder of the vocal apparatus. It is, therefore, possible that they too may be affected in a similar manner as intensity and rate are involved. We do know, however, that the latter cause is limited in that large numbers of wounds of the face and jaws without tracheotomy have dyslalia alone with dysphonia only in relation to intensity and rate. Therefore, it is logical to assume that to explain the majority of changes in pitch and quality some associated structural or neurological alterations in the larynx must be present.

THERAPY

It is to be emphasized that speech re-education has no place during initial debridement in theaters of operation or in the succeeding phases of reparative surgery in the communications zones. It is indicated only at the conclusion of all specific reconstructive surgical procedures in the zone of the interior when there is some residual speech defect present. On the whole, satisfactory compensation has been achieved by this time in most cases, but certainly in those with residual problems, speech rehabilitation is of value.

In order to understand the articulatory errors resulting from structural lesions on the basis of maxillofacial injuries so as to plan adequate therapy, it is necessary to know how the various components of the articulatory apparatus (lips, teeth, alveolar margins, tongue, soft and hard palate) enter into the normal mechanism of sound production. Sounds have been classified in two ways: 1. The manner in which the sound is produced, such as the plosives (p,b), nasals (m,n) etc. 2. The position of the organs of articulation in the formation of the various vowels and consonants, e.g., the bilabials (p,b), labio-dentals (f,v), etc. A good working knowledge of the International Phonetic Alphabet is also essential for accurate and universal tabulation of the defects present. This material has been fully covered in a previous publication (3). For example, when the bilabials p and b and labio-dentals f and v are involved, the labial lesion may be structural (gunshot wound) and/or neurological (peripheral facial paralysis) etc. In any event, treatment is similar from the speech standpoint, i.e., whether structural or neurological depending upon which part of the articulatory apparatus is disturbed. This phase has been covered recently in relation to dysarthria (5) and dysphonia (6). The paper on dysarthria is applicable to cases of dyslalia as both are associated with impairment of articulation, the only varying factor being the etiology. The article on phonatory problems included all aspects of management including medical and surgical measures (esophageal speech in avulsion wounds of the larynx etc.).

Cases with residual speech defects necessitating therapy after specific plastic surgical procedures were completed were found usually in those with cicatricial

contractures between the tongue and floor of the mouth (see figures 1 and 2); considerable loss of the tongue (see figures 3 and 4), and structural and/or neurological damage to the laryngeal mechanism. Release of adhesions in relation to the tongue and floor of the mouth has given occasionally further improvement in speech although it is difficult to prevent new scar formation post-operatively as previously noted. Following surgery, some of the sounds were articulated correctly, but were diminished in force and amplitude such as the bilabials after reconstruction of the lips. Physiotherapy and speech re-

FIG. 5. EXTENSIVE PALATAL DEFECT WHICH WAS REPAIRED SUCCESSFULLY

education have resulted in additional advancement in cases of this type. On the whole, it is safe to say that adequate compensation can be obtained in practically every patient with an articulatory and/or vocal disturbance, whether structural and/or neurological following adequate speech therapy, and this often in the presence of residuals as noted above, (loss of tongue, etc.).

In cases of palatal perforation (see figure 5), specific surgical therapy must be undertaken to close the intra-oral defect either by a local or pedicle flap as indicated. A permanent obturator is rarely necessary, although often useful during preliminary treatment to facilitate speech and mastication. All sounds

FIG. 3. LOSS OF THE ANTERIOR ⅔ OF THE TONGUE WITH FIXATION OF THE REMAINING PORTION TO THE FLOOR OF THE MOUTH

FIG. 4. RESIDUAL LOSS OF THE ANTERIOR ⅓ OF THE TONGUE FOLLOWING PLASTIC RECONSTRUCTION OF THE LOWER LIP AND CHIN

ment has been noted in all cases of this type. This has been true also in patients with associated dysphonia from laryngeal pathology.

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are defective usually prior to surgical relief excepting occasionally the nasals (m,n, and ng). The post-operative rehabilitation problem here is somewhat different from congenital cases where poor speech habits and psychological traits are well developed often before surgery is undertaken. Exercises are indicated in any event, to strengthen the palato-pharyngeal muscles (5), and psychological technics must be added as necessary. On the whole, good results are obtained at the conclusion of surgery and speech therapy and only occasionally is there a slight tendency towards nasalization of the sounds. This is more apparent if a permanent intra-oral prosthesis is required.

In most fractures of the jaws there is associated loss of the teeth. The incisors particularly are important for accurate production of the labio-dental sounds and the sibilants. Errors from this standpoint are temporary and readily compensated for following fitting of adequate dentures. In those with residual maxillary and mandibular deformities of such a degree to obviate complete dental reconstruction, satisfactory articulation can be achieved by speech therapy.

The effect of trismus must be mentioned, although clarified generally during the course of surgical treatment. In the few cases that it remains there is a reduction in the oral outlet sufficient to interfere with vocal production due to amplifying and resonating factors. Also, articulation is not clear (particularly the bilabials) because of occasional structural involvement of these organs. Chewing and jaw exercise are indicated in addition to plastic surgical methods (5).

CONCLUSIONS

The various types of speech disturbances resulting from maxillofacial wounds have been described. Those on a structural basis are termed dyslalia; whereas those due to a lesion of the central or peripheral nervous systems are designated dysarthria. Both cause disturbances of articulation. There may be associated vocal changes in this type of injury particularly in relation to intensity and rate but dysphonia may also be present due to concomitant laryngeal damage, structural and/or neurological. In these instances we find alterations also in pitch and quality. The latter characteristics are rarely present in maxillofacial injuries alone as they are properties of the vocal cords and subject only to further amplification and resonation through the oral outlet. Changes in voice have been observed following tracheotomy regardless of the length of time of cannulation if a careful history is elicited and even in the presence of normal laryngoscopy. The cause of such findings is difficult to explain, but may be associated with preliminary treatment and post-operative care. The majority of the casualties of this type showed complete subsidence of articulatory defects following reconstructive surgery. Often, the only residuals were in reduction of intensity of the voice and force in speaking. In those patients with minor remaining defects, speech re-education is indicated, such as those with slight nasality in previous palatal perforations; major lingual injuries; adhesions between the tongue, floor of mouth and buccal margins, etc. Definite improve-

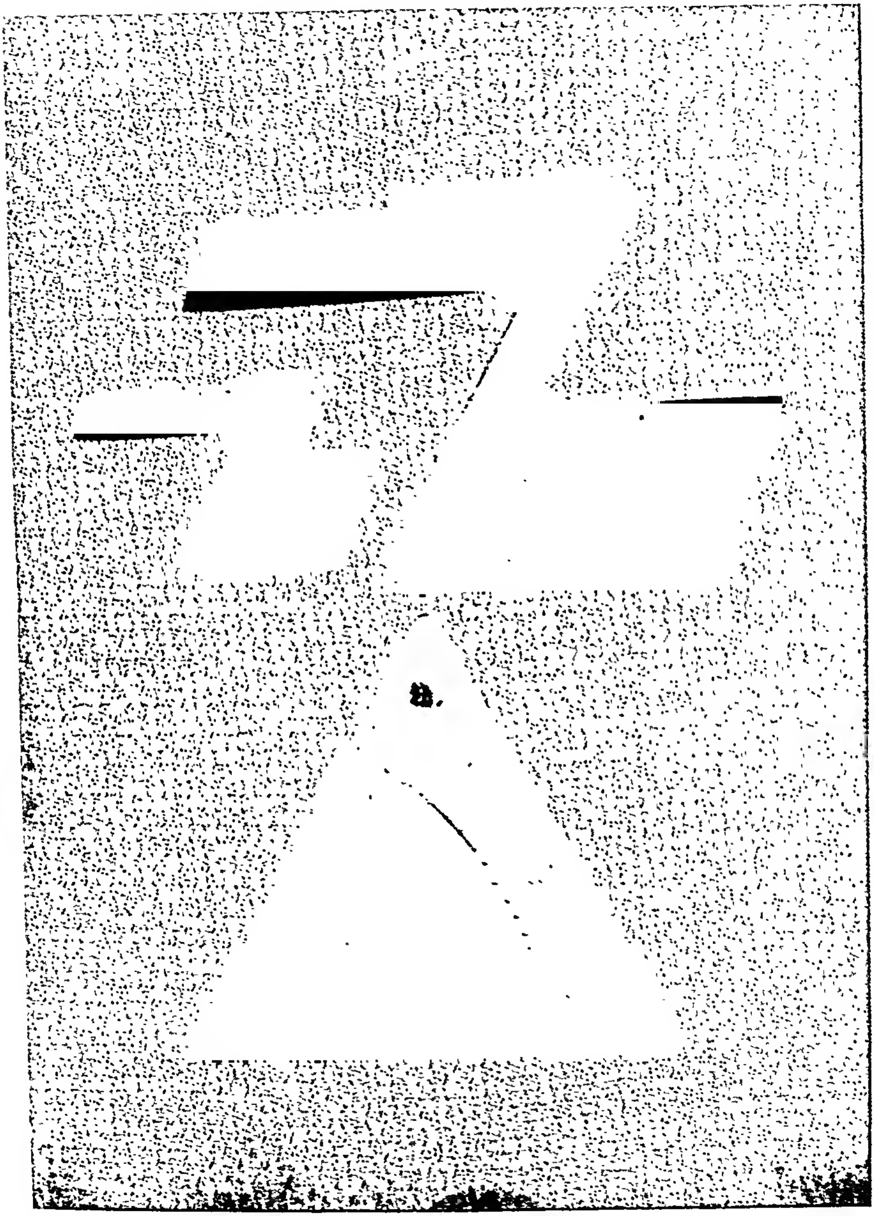

FIG. 1

TEMPLATES AS AN AID IN MARKING OUT Z-PLASTICS

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The principle of the Z-Plastic was probably known centuries ago. Denonvilliers, in 1856, was the first to record such a procedure. Its usefulness was then lost to the profession until A. A. Lemberg of Leningrad, a mathematician as well as a surgeon, very ably demonstrated the geometric problem involved and interpreted it into a useful and sound surgical principle.

Between 1919 and 1939 the procedure was again revived and popularized by Ferris Smith, John Staige Davis, E. A. Kitlowski and others. In the earlier days its use was chiefly for the relief of contractures, by utilizing width to gain length. As more study was devoted to this problem it was found that the Z-Plastic had other uses equally satisfactory. To mention a few: (1) breaking the pull on scars, (2) raising a lowered angle of the mouth or outer canthus of the eye and (3) combining the Z procedure with multiple excision which permits the complete substitution of normal for pathologic tissue of the face without consequent distortion of eyelids, nose or angles of the mouth or ears. There are many more uses and modifications of the Z principle; however, the few examples given are sufficient to prove its worth.

To do meticulous work one must use accurate instruments. The templates presented in this article (Fig. 1) are probably not original and are not described as such. I, however, have never seen anything similar and am describing them only as instruments of precision for marking out Z-Plastics. In my own experience they have proved very helpful because they guaranty accuracy and speed in mapping out the procedure.

In marking out a large sized Z, accuracy is not so important as the larger triangular flaps have more flexibility. This, however, is not the case when smaller Zs are used; these must be very exact, otherwise one will experience some difficulty in effecting a neat closure after the flaps have been transposed.

Some years ago I devised the equilateral triangle as a guide in order to cope with this problem. One side is marked off in one-fourth inches while a second side is described in angles of twenty, thirty, forty and fifty degrees. Occasionally a case merits unequal angles or angles less than sixty degrees. This template worked out very well except for one factor. To lay out a Z, one side of the triangle is placed on the web or scar. The central member and one leg can then be marked out with brilliant green in alcohol. In order to complete the Z, the triangle has to be picked up, turned over and placed again on the web while the other leg is marked. This maneuvering usually results in blotting the wet dye so that at times the resulting diagram is not very usable. The good feature of the triangle is that any sized Z can be made, since one side is calibrated in inches.

After working with this equilateral triangle for some time and observing its

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AN OBTURATOR FOR USE IN FEEDING CLEFT PALATE CASES

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The difficulties attendant upon feeding babies afflicted with cleft palate entered into a discussion following a meeting at which Dr. Lyndon A. Peer read a paper on repair of clefts. It was suggested that some form of obturator could be constructed so that the cleft could be closed during the time the nurse was giving the baby the nursing bottle. I examined a number of cases with this thought in mind but several difficulties were apparent. First, the necessity for making an impression of the mouth and constructing an applicance for each individual case: Second, the difficulty of retention once it was made: And third, the very possible danger of the apparatus slipping back into the throat or up into the nasal cavity.

A B C

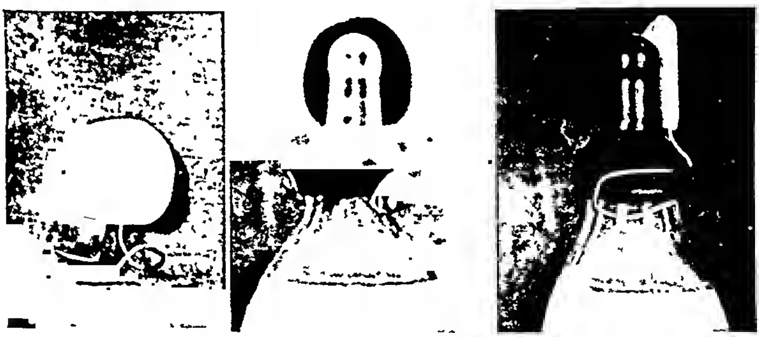

FIG. 1. A–B–C. Obturator and its method of attachment to nursing bottle.

The idea of constructing an obturator which could be attached to the nursing bottle, one which could be used in any case and of simple and inexpensive construction appealed to me, and after some experimentation, I devised such an appliance. It is now in use at St. Barnabas Hospital, Newark, in Dr. Peer's service, and has proved to be very satisfactory.

The baby takes its feeding in a nearly normal manner, and a great deal of the nurse's time is saved, as compared with dropper feeding. Cleaning and sterilization is very easily accomplished.

The obturator is made of plastic (Lucitone), with stainless steel wire clasp to grip the neck of bottle where the rubber nipple covers it. The accompanying pictures show the appliance and the manner in which it is attached to the bottle.

The dimensions of the plastic obturator are 1 inch in width, $1\frac{1}{4}$ inches long

short comings, I felt that if a template could be made about which a Z could be drawn in one continuous movement, a neater and more accurate diagram would result. With this in mind I made the two Zs from rustless steel as pictured below. The smaller Z contains one-half and one inch sizes, while the larger contains one and one-half and two inches. The points are fairly well blunted and may be made more so if desired. It is best that the sharp points of the Z should be blunted when the flaps are cut, as the tips of sharply pointed flaps are very apt to necrose. Although the Zs are fixed in size, they work out very well. To make them more flexible a rule could be stamped along one edge of the body of the larger Z or "duck," similar to that on the triangle. The photographs are published full scale so that they may be copied should one desire to make a similar set.

Plastic surgeons who have performed large numbers of Z-Plastics and who are endowed with a good eye for distance and angles will find these templates useful only as a rapid check on their judgment. Their greater use will be found with general surgeons who but occasionally mark out Zs for this type of plastic procedure.

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IN MEMORIAM

Earl C. Padgett, M.D.

Earl C. Padgett, widely known plastic surgeon, died at Kansas City, Missouri, December 2, 1946, aged 53.

Dr. Padgett was born in Greenleaf, Kansas, July 8, 1893. He attended the schools at Glascow, Kansas and was active in athletics. He received the Bachelor of Science degree at the University of Kansas and his medical degree from The Washington University Medical School. He went overseas during the first World War as a private with Base Hospital Number 21, getting his degree overseas. Upon his return he served at the Barnes Hospital in St. Louis, securing his surgical training. At the completion of his residency he became associated with Dr. Vilray Papin Blair for two years, specializing in Oral and Plastic Surgery.

During the latter part of his interneship he married Winona Youmans of Osawatomie, Kansas and they had three children, Joyce, Patricia and Earl Calvin, Junior.

Dr. Padgett began the practice of General Surgery in South Dakota and then in New Mexico. He then returned to Kansas City and became affiliated with the University of Kansas as an instructor in Surgical Anatomy and Experimental Surgery. In 1936, he became professor of Clinical Surgery. He was also professor of Maxillo-facial Surgery at the University of Kansas City Dental College.

He was a member of the Providence Hospital Staff, Kansas City, Kansas and of the Percy General Hospital, St. Mary's Hospital and St. Lukes' Hospital of Kansas City, Missouri.

Dr. Padgett was the author of numerous articles in the field of Plastic Surgery. In 1938, he presented the Dermatome at the meeting of the Western Surgical Association. This instrument designed to cut skin grafts of a calibrated thickness was developed in collaboration with George F. Hood of the Department of Engineering of the University of Kansas.

Known as the Padgett Dermatome, it has given the surgeon a method of securing skin grafts with relative ease and was of great value during the past War.

Dr. Padgett was the author of "Surgical Diseases of the Face, Mouth and Jaws," published in 1938 by W. B. Saunders, and "Skin Grafting From a Personal and Experimental Point of View," published in 1942 by C. C. Thomas. A third book, covering the field of Plastic Surgery is to be published by C. C. Thomas in 1947.

Dr. Padgett was a member of the Founders' Group of The American Board of Surgery and The American Board of Plastic Surgery. He was a fellow of the American Medical Association, American Association for the Surgery of Trauma

and about $\frac{3}{16}$ inch thick, and it is roughly oval in shape and slightly concave, with concave side to the nipple.

Stainless steel wire of 19 gauge (.036) is imbedded in the plastic when the appliance is made. Any good dental mechanic can make it and the cost is very moderate.

If any one in need of one of these appliances, experiences difficulty in having it made, I will gladly furnish information concerning pattern and technique.

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and the American Surgical Association. He was a member of the American Society of Plastic Surgeons and the American Society of Plastic and Reconstructive Surgery.

Dr. Padgett was an earnest, sincere worker, well liked by his associates and his students.

His remarks were very stimulating at the various meetings and his presence will be missed. The contribution of his mechanical apparatus for taking skin grafts, upon which other types have since been based has been of great value to surgeons.

EDWARD A. KITLOWSKI, M.D.

Earl C. Padgett, M.D.

few of the severe cases. There was little infection noted, and the clinical course in the 43 healed patients was satisfactory. Grafts were required infrequently but most often in the thermal burns. The extent or depth of the skin involved was not an accurate indication of the seriousness of a burn. Of great significance was the kind of burn, which should be described as flame or scald, and, when possible, in terms of the duration and temperature of the burn stimulus. For example, in this series, none of the 21 hot water burns proved fatal and only two required skin graft, yet a third of them involved 30 per cent or more of the body surface. Vomiting, shock and toxemia are observed early in fatal cases, and special therapy is indicated to reduce the mortality further in these cases.

Goodpastor, W. E.; Levenson, S. M.; Tagnon, H. J.; Lund, C. C., and Taylor, F. H. C.: A Clinical and Pathological Study of the Kidney in Patients with Thermal Burns. *Surg. Gynec. Obst. 82:* 652, June, 1946.

An attempt was made by Goodpastor and his associates to correlate the clinical and pathological findings in a series of 47 patients with fatal thermal burns admitted to the Boston City Hospital during a period of slightly less than 2 years. The area of burn was estimated by the method of Lund and Browder, and the depth of the burn described according to the new method of Converse and Robb-Smith, using the descriptive terms epidermal, dermal, deep dermal, mixed and deep to estimate the degree of burn. The local treatment comprised triple dye and tannic acid silver nitrate in the earlier cases, and pressure dressings or casts, dry or with bland ointment, in the later group. Recognized sedation and necessary supportive therapy were given routinely.

In the series of 47 patients, 20 had abnormal kidneys at autopsy, except two, who showed pyelonephritis. Renal lesions showed tubular necrosis with pigment or cellular casts in the tubules. The remaining 27 patients had no significant renal morphologic changes. The pigment casts gave positive "hemoglobin stains," but further specific identification was not made. Renal dysfunction was the probable cause of death in only two patients, but the usual clinical manifestations were persistent azotemia, oliguria, decreased urinary nitrogen excretion and rarely, edema. A close correlation was found among the renal dysfunction, morphologic abnormalities of the kidneys, the extent of deep burn, the severity of shock, and the presence of hemoglobinuria. It would appear that prompt and vigorous prophylaxis and treatment of shock are important in preventing renal damage. In the presence of renal dysfunction, however, care must be taken in the administration particularly of sodium-containing fluids, to avoid overloading the circulation.

Most of the patients in this series died of causes other than renal failure, but if these complications had been avoided possibly many might have gone on to death from renal failure. Extravascular or peritoneal dialyzation if carried out practically and successfully would be useful to tide the patient over until the renal tissue has had an opportunity to regenerate and function possibly be restored.

SKIN GRAFTS

Cannaday, John E.: Cutis Graft in Surgery. *Arch. Surg. 52:* 286, Mar. 1946.

Cannaday reports additional cases in which the cutis graft has been used successfully because it "vascularizes quickly," "takes" easily and well and is gradually transformed into fibrous tissue. When cutis is used for reenforcement purposes he advises that the subcutaneous fat should always be carefully sutured down to, and over, the cutis graft so as to obliterate the dead space in the incision. Preoperatively, care is taken to prepare the skin area in order to avoid infection. In the 129 cases included in the report the author performed cutis grafts in 81 in which were 4 cases of minor infection and 3 cases of cellulitis. Other members of the surgical staff carried out 48 cutis grafts in repair, with 2 severe wound infections. The cutis graft has been found particularly useful for the treatment of incisional hernia and prolapsed uterus, and to replace fascia as a substitute for the lateral ligaments in the repair of a wabbling knee. It has also been used to support the bowel, to replace dura and to ligate the common

May 1947

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

BURNS

Elman, Robert; Merry, C. R.; Beguesse, Celsus E., and Tisdale, Raphael: Severe Burns: Clinical Findings with a Simplified Plan of Early Treatment. *Surg. Gynec. Obst. 83:* 187, Aug. 1946.

A series of 55 severe burns (with 10 per cent or more of the body surface involved) is presented by Elman *et alii*, with emphasis on a plan of treatment reduced to its simplest details. Early careful study and individualization of each case are important, however, and potentially fatal burns may require special methods of treatment or more intensive therapy to minimize the mortality. Local treatment, without debridement but with some local cleansing of the adjacent areas, consisted of the immediate application of dry sterile gauze pressure dressings left in place up to 14 days. A rigid aseptic technique was followed since infection of burned surfaces can be traced to bacteria which reach the burn after the patient enters the hospital. Plasma transfusions were required for circulatory impairment in only 10 of the 43 healed patients. Morphine for relief of pain was used in 9 of the 55 cases. A high fluid and food intake was important, and the oral route was employed in all but a

with the cartilage. The procedures advocated for the repair of saddle nose and deformities resulting from dislocation of the lower septum are well illustrated by diagrams. The excision of the distorted lower septal cartilage and its reinsertion as a free graft between the mucous membrane flaps are advocated.

Attention is called to the growth of young cartilage. Peer reports the results obtained after carefully examining measured autogenous cartilage buried in infants and children. This observation indicates actual growth of young human auricular and septal cartilage grafts.

Editorial Comment: This paper is a very timely one, and the author deserves credit for calling attention to the usefulness of the septal cartilage as grafting material.

Unfortunately the septal cartilage is usually severely traumatized in pronounced saddle-back deformities and does not often offer enough supporting material for the repair. Grafts for limited depressions in the middle third of the bridge or a supporting strut to the tip can frequently be made available from the septum. Larger losses, however, can not, as a rule, be adequately repaired by autogenous septal graft.

The author's method of reinsertion of the excised dislocated septal cartilage as a free graft is interesting and may have its indications. Generally, however, the preservation of the mucoperichondrium in shaping of the deflected septum is simpler and often essential for the adequate support of the cartilage in a proper position. The placement of a free graft between the mucous membrane flaps is indicated in instances of loss of anterior septum due to excision or necrosis.

Cohen, Samuel: Planning the Rhinoplasty. *Arch. Otolaryng. 43:* 283, Mar. 1946.

Cohen describes the generally accepted requirements for planning and carrying out a nasal reconstruction for external deformity.

Fox, Samuel L.: The Use of Thrombin in Rhinologic Surgery; a Preliminary Report. *Laryngoscope 56:* 48, Feb. 1946.

The use of thrombin in rhinologic surgery is advocated by Fox. In his opinion, fibrin fixation of tissues prevents postoperative edema and tissue thickening. The report is based on 29 cases, 6 of which were rhinoplasties.

EYELIDS

Fox, S. A., Lt. Col.: Some Methods of Lid Repair and Reconstruction. *Am. J. Ophth. 29:* 452, Apr. 1946.

Fox suggests another method of repairing a notch deformity of the eyelid by using a vertical sliding flap of tarsus from the opposing lid. Over this, sliding flaps from both sides are brought together for closure of the skin. The author also stresses the importance of firm tarsorrhaphy when long lid margin defects are repaired. Several cases are reported.

Callahan, Alston: The Removal of Adjacent Nevi of the Eyelids. *Am. J. Ophth. 29:* 563, May, 1946.

Excision of the lateral halves of both lid margins containing pigmented nevus is reported by Callahan. Repair was done by splitting the remaining tarsus from the superficial tissues, suturing the tarsal edges together and using full-thickness skin graft from the opposite upper lid for skin covering. Two and one-half months later an eyelash graft for the upper lid was taken from the eyebrow of the same side. The eyelids were separated three months later. Quite satisfactory results were obtained.

FACE AND NECK

Campbell, H. H.: A Method in the Management of Multiple Facial Fractures. *Surgery 20:* 204, Aug. 1946.

A case of multiple facial bone and jaw fractures resulting from a motorcycle accident is reported by Campbell in some detail to illustrate the author's treatment given to 21 patients with such injuries. The patient in the discussed case had fractures of the ethmoid, nasal, maxillary, mandibular and both malar bones.

Through small supraorbital incisions just above the outer third of the eyebrows, interosseous wire loops were inserted into drill holes between the two external angular processes and the frontal bone after malar reduction. A piece of wire was passed through each of these loops and, with a probe drawn downward behind the malar bones and brought out in the upper buccal sulcus on

carotid artery. Cannaday suggests that it could be used to advantage in permanent ligation of the aorta and for the reenforcement of certain types of aneurysm.

Branch, C.; Wilkins, D., and Ross, F. P.: The Coagulum Contact Method (Sano) of Skin Grafting in the Treatment of Burns and Wounds. *Surgery 19:* 460, Apr. 1946.

The authors' simplified set-up for carrying out the coagulum contact method of skin grafting is described. In most instances of burns and wounds dermatome grafts varying in size from 4 to 5 cm. in diameter to 5 drums, of a thickness of .015 inch, were used. The recipient areas were irrigated with saline solution, blotted and covered with a film of penicillin of 5,000 units up per cubic centimeter of solution and allowed to dry prior to the application of plasma. The cell extract was applied to the graft. If the area was large they did the grafting in stages. Postoperatively, sprays of sulfanilamide and acetic acid were used, starting 2 hours following grafting. The ointment gauze form of dressing they completely abandoned, feeling that it prevented the escape of exudate. Of the 120 cases, in 5 cases there was total loss, in 9 cases 5 per cent loss, in 22 cases 25 per cent loss. In one instance, Branch *et alii* applied homogenous grafts on areas on the same patient. These grafts were 2 x 1, 4 x 8, and 9 x 3 inches in size and had a survival time of 135, 130 and 75 days. The authors feel that the method has certain disadvantages, namely, less coverage is gained because of contracture of the graft when it is applied, and the cosmetic appearance is not so good. The advantages are that the skin grafts are satisfactory in application over areas where pressure is difficult to obtain namely, in gluteal folds and in the trachea, and are useful where suturing is difficult as in large burns.

Editorial Comment: Since generally the method has been regarded as superior from a cosmetic viewpoint by the advocates of this type of graft, the observations by Branch and his colleagues are of interest. Experimentally the homogenous grafts suggest usefulness. It is difficult, however, to conceive of a situation in which the coverage of such small areas would be sufficiently important to demand homogenous grafts.

Greeley, Paul W.: The Plastic Correction of Superficial Vascular and Pigmented Nevi. *Surgery 19:* 467, Apr. 1946.

Greeley presents a series of 15 cases in which the patients had received surgical therapy for vascular or pigmented nevi. He feels that in all cases which are not too extensive treatment should be given by the multiple excision method. Most frequently the author uses a full thickness skin graft about the face and hands; in one case he swung a tubed pedicle flap because the question of immobilization seemed to him to preclude grafting. In the care of the large cavernous angiomas, because of their great vascularity an operation, in his opinion, should be preceded by the injection of sclerosing fluids, partial ligation or exposure to radium or x-ray in order to prevent hemorrhage. In one case with extensive involvement of the face the external carotid was ligated and the mass given x-ray therapy prior to application of a split skin graft. Split thickness skin grafts, however, are not used by the author unless deemed absolutely necessary because of the underlying fibrosis that has developed. In one case it required five operative procedures in order completely to remove the large angiomatous tissue and attain skin coverage.

NOSE

Peer, Lyndon A.: The Neglected Septal Cartilage Graft. *Arch. Otolaryng. 42:* 384, Nov.–Dec. 1945.

Peer stresses the importance of using autogenous septal cartilage as supporting material in nasal losses. This graft has proved experimentally to survive transplantation without any changes, showing normal cells and absence of invasion. In a series of microphotographs the author demonstrates good preservation of septal, alar and auricular cartilage as long as 4 years after they were buried under the skin. He prefers the use of septum to that of rib cartilage because the former is readily obtainable. As young cartilage seems to show active growth following transplantation, Peer favors its use in children. Septal bone is well preserved as a free graft and can be used in conjunction

amount of manipulation was done, but penicillin and sulfadiazine were given

End results are not reported, for the stay aboard the hospital ship was short

MOUTH AND LIP

Martin, Hayes: Mouth Cancer and the Dentist. *J Am Dent A* 23 845, July, 1946

In this article, written for dentists, Martin points out that the main hope for a patient with cancer of the mouth lies in his dentist, who may make an early diagnosis and refer him to a physician for further care The few symptoms which an early cancer of the mouth may produce often cause the layman to go to the dentist, because he feels that the trouble is with his teeth, or in some other dental disorder For example, 59 per cent of 100 patients with cancer of the gum in Martin's series consulted a dentist before a physician The author also states that in the series of 157 cases of cancer of the mouth, 60 cases, or 38 per cent, were probably recognized by the dentist and referred to the hospital On the other hand, in the series of cases of cancer of the mouth, 97 cases, or 62 per cent, were probably not recognized by the dentist, and the average time between first seeing the dentist and first seeing a physician was eight months

He discusses under the symptomatology of cancer of the mouth the fact that these lesions may resemble gumma or other syphilitic manifestations, tuberculosis, Vincent's disease and several other commonly found lesions He also discusses the fact that pain is often not present until late in the course of the disease, when secondary infection complicates the picture Then marked pain, restriction of movements of the tongue and jaws, painful swelling, and salivation are usually present

For early diagnosis Martin makes the following rules " In any suspicious lesion of the mouth, both physician and dentist should consider cancer first and should rule out such a possibility before waiting 'to see what happens' or proceeding with treatment on the basis of a benign diagnosis " Another important fact to establish in the history of a suspected mouth cancer is that the lesion is chronic and progressive If the lesion has an acute onset and is healed in 5 to 10 days or so, its likelihood of being cancer is slight

The author discusses in some detail leukoplakia and its role as a pre cancerous condition He recommends that a dentist, diagnosing leukoplakia, refer the patient to a physician for periodic examination In dental abscesses he warns the dentist always to suspect cancer, if any soft tissue clings to the root of the tooth, the entire specimen should be sent to a pathologist for study

Regarding biopsy, Martin points out that when the dentist knows the patient will go for medical advice, he should allow the physician or the hospital to carry out the biopsy procedure, but when he suspects that the patient may not heed his advice seriously and seek medical consultation, the dentist should perform the biopsy himself This should be done in any suspicious lesion of the mouth He warns strenuously against the curetting of an adamantinoma, for this releases the growth from its restraining bony walls and the tumor spreads more rapidly in the overlying soft tissues The infection which subsequently results makes treatment in order to be effective far more radical

Under causative factors are discussed the use of tobacco, avitaminosis, syphilis and dental disorders The point is made that usually more than one of these factors play a role Martin remarks that the dentist who does periodic examinations of the oral cavity can very often diagnose these conditions before cancer is present, and that he should either warn the patient or refer him to a physician He discounts, to a large extent, the role of dental disorders in the etiology of cancer of the oral cavity

The author believes that the dentist should never extract teeth if there is any suggestion of mouth cancer, except on the advice of the physician who is to treat the growth This he recommends for two reasons If a malignant tumor is already present there is serious danger of permitting deep invasion of the growth through the lacerated gum and tooth socket In addition, there is the danger that this type of treatment may prevent the patient from seeking medical advice for a considerable length of time, as he will be satisfied for a while by the fact that something has been done

Lastly, Martin discusses the prognosis of

each side. The teeth were wired together by half-round German silver wires fastened to the maxillary and mandibular teeth. The submalar wires were then pulled forward in the buccal sulcus and attached to the upper dental bar in the premalar region. This drew the malar bones inward and rotated them forward and upward. A long facial bar was fastened to the half-round dental bars and to a plaster head cap. To this facial bar was attached a stirrup supporting the nasal fragments. No packing was used in the nose so that drainage from the nose and sinuses could be maintained.

About 10 days after the first operation, when swelling had subsided, the fragments were readjusted. After 4 to 5 weeks, the appliances were removed.

The writer reports no complications and believes that by this method excellent control of the fragments can be achieved.

Gibson, T.: Large Missile Lodged in the Face with Minor Clinical Disturbance. *Lancet 1:* 13, Jan. 5, 1946.

As reported by Gibson, a patient walked into a maxillofacial unit 8 hours after injury, complaining of a small laceration of the left cheek and some stiffness of the lower jaw.

The maxillary block was firm but the mandible was swung to the right. Besides the laceration, 1 inch in front of the left ear, and swelling of the left cheek, there were no other signs or symptoms.

At operation, a 20 mm. cannon-shell, 85 mm. long and weighing 147.3 grams, was found. The wound tract passed through the coronoid process of the mandible, behind the maxilla, and into the nasopharynx. The condyle was fractured. After the cavity had been powdered with penicillin and sulfathiazole, the skin wound was trimmed and completely sutured.

Temporary intermaxillary fixation was provided by two pairs of eyelet wires, which were later replaced by cast metal splints incorporating a guiding flange.

The only postoperative complication was the development of a salivary fistula, presumably from injury by the missile to part of the parotid gland or to the parotid duct.

Wiser, H. J., and McAfee, M. F.: Injuries of the Face and Neck in War Casualties. *U. S. Nav. M. Bull. 46:* 57, Jan. 1946.

This report by Wiser and McAfec concerns neck and face injuries treated aboard a hospital ship during the Second World War.

The urgent problems encountered besides severe coincidental injuries were shock, hemorrhage, and respiratory distress. The patients were often taken directly to the operating room for arrest of hemorrhage or for tracheotomy or both. Tracheotomies were done early if the patient showed signs of respiratory distress. Local anesthesia was usually employed for these operations, and the tube inserted through the second and third cartilaginous rings. The prognosis was poor when the respiratory obstruction was due to central depression.

For the first 24 to 48 hours all feeding was given intravenously. As soon as the patient's condition permitted, a nasal feeding tube was inserted and a high protein liquid diet started.

Fluoroscopy proved very valuable in removing foreign bodies. However, the authors urge great care in the removal of foreign bodies lest more damage be done by the fragment on the way out than was caused by its lodgment in the tissues.

Their experience in having to remove sutures, establish drainage, and apply wet soaks in nearly every one with facial wounds which had been closed before the patients came aboard the ship leads them to say, "Tight closure (closure without drainage) of facial wounds should never be done."

Secondary closure of the wounds, with drainage, following careful cleansing and conservative debridement was the authors' policy.

With the exception of a small percentage of simple fractures resulting from accidents, most of the fractures were compound and comminuted and ranged from small to extensive loss of soft tissue and bony parts. In the severe injuries it was not considered advisable to attempt early fixation of jaw fragments until the patient's condition had improved and edema had subsided.

Use of arch bars with rubber-band traction was the usual method of reduction and fixation of mandibular or maxillary fractures.

Depressed zygomatic fractures were elevated by routinely accepted methods.

Nasal fractures were elevated and manipulated under local anesthesia.

If rhinorrhea was present, a minimum

reports 13 cases of surgical reconstruction of the thumb.

The methods of reconstruction were: (1) deepening the thumb web; (2) pollicization of a remaining partial finger; (3) replacement with a toe; and (4) lengthening the existing thumb stump. The aim is to establish the opposing mechanism of the thumb against the other fingers.

Deepening the web between the thumb stump and the metacarpal of the index finger is the quickest and simplest procedure. It gives no length to the thumb but the ability is acquired to hold tools between the thumb and hand. Pollicization of the index finger should be limited to patients with simultaneous subtotal loss of the index finger.

Replacement with a toe was described by Nicolandini. The great toe should not be sacrificed because that procedure impairs the balance of the foot. Another toe with its tendons and phalanges is transplanted to the thumb by the pedicle flap method. The required position is awkward and makes the procedure difficult.

Lengthening of the thumb stump is done by constructing a tube pedicle flap from a hairless area in the flank and transferring it to the thumb stump. Three to four weeks pass before the abdominal connection of the tube is severed with the use of "delays," or by constructing the proximal end with rubber bands. After the flap has healed completely and become well softened, it is stabilized on the base of the thumb by the use of a bone graft from the twelfth rib. Exposure of the twelfth rib is by an incision, with retraction of underlying muscle or division of it. The rib is exposed and removed subperiosteally; the wound is closed in layers. The rib graft is shaped to form a peg in its proximal end, and several small holes are drilled through the bone to encourage rapid vascularization. The bone graft is transplanted into the healed tube. An incision is made at the base of the pedicle, a hole is drilled in the metacarpal and a tunnel in the center of the tube. The graft is placed distally into the tube pocket, and the peg on the proximal end is pushed into the metacarpal hole. The skin incision is sutured, and the thumb supported by a splint or plaster of paris cast. Union occurs in 2 to 3 months and healing as established by roentgen ray is completed in 6 months.

Complications: (1) The most common complication is a breakdown of the end of the tube pedicle flap after separation from the abdominal origin. This was seen in 80 per cent of the cases. After closure of the open end by suture primary healing occurs, but in 10 to 18 days cyanosis and gangrene develop at the tip. An ulcer forms and must be excised, and the flap end must be resutured to obtain permanent healing.

(2) Infection and necrosis of the bone graft were seen in 20 per cent of the cases in the series.

(3) Fracture of the bone graft due to trauma from premature use was seen in one case.

Webster, George V., and Willard, D. Rowland: Skin Grafting the Burned Dorsum of the Hand. *Ann. Surg., 124:* 449, Aug. 1946.

As pointed out by Webster and Rowland, the skin of the dorsum of the hand is elastic to accommodate itself to stretching when the fist is clenched and retraction when the fingers are outstretched. Its resistance to trauma is poor, but it is not subject to excessive friction or to mechanical shock.

Because the skin is thin, its elastic fibers are near the surface and are easily damaged by thermal injury. Although a second degree burn may completely heal without grafting, there may be sufficient damage to the elastic fibers to impair function. In third degree burns, local bacterial invasion followed by fibrosis and stiffening cripple normal function. Burns of the dorsum are more frequent than those of the palm because of protective reflexes and the predominance of the flexor muscles in the latter.

In burns of the dorsum of the hand, there is extreme need for early grafting to minimize fibrosis by early closure of the wound. Local care of the wound is based on the principles of cleanliness, compression and rest. However, after the first few days, daily baths in normal saline, accompanied by exercise to keep the joints elastic and the fingers movable is the method that achieves the best results. In the general care of the patient nutrition requires special attention. He must be fed adequately, quantitatively and

cancer of the mouth. He strongly decries the belief among the laity, among some doctors and dentists that cancer is incurable and quotes the statistics of the Head and Neck Clinic at the Memorial Hospital in New York. For instance, the percentage of 5-year cures in all cases of cancer of the lip was 70 per cent; in the early cases with the primary lesions less than 2 cm. in diameter there was 86 per cent of 5-year cures. The most striking difference between these two groups was in cancer of the tonsil, in which 18 per cent showed 5-year cures in all cases both early and advanced, while 40 per cent showed 5-year cures in the early cases when the primary lesions were less than 2 cm. in diameter.

Chambers, J. V.: Plastic Reconstruction of Lip following Gunshot Wound; Report of a Case. *U. S. Naval M. Bull. 46:* 588, Apr. 1946.

Chambers reports a case of extensive injury to the soft tissues of the jaws, lip, and tongue in a 21-year old male caused by an enemy bullet. The patient also had a compound comminuted fracture of the mandible with loss of teeth.

Sulfonamide dressings were applied but the fragments of bone were not fixed until 9 days later. A Roger-Anderson splint was used. Osteomyelitis of the mandible occurred. Six weeks later the splint was removed.

Three months post-trauma the patient was transferred to a hospital in this country. Roentgenograms showed beginning bony union, osteomyelitis, and numerous shell fragments lodged around the jaw and in the neck. External and intraoral fistulae were present.

Six months post-trauma an open reduction was performed with the use of a vitallium plate and screws. A Winter arch bar with elastic traction was employed to obtain occlusion. Three weeks later the elastic traction was removed, and two months later the vitallium plate and screws were removed.

Partial dentures of acrylic resin with cast clasps were constructed to give a normal contour on which to base the repair of the lip. The lip reconstruction required four more operations.

Denen, H. E.: Prosthetic Restoration Following Gunshot Injury of the Maxilla. *U. S. Naval M. Bull. 46:* 1218, Aug. 1946.

Denen reports a case of a 20-year old male with loss of the anterior portion of the maxilla with all teeth from the right second molar to the left first molar caused by a bullet wound.

The labial frenum was intact but presented a prosthetic problem because it had been drawn posteriorly when the mucous membrane had been attached to the healthy periosteum.

Because the teeth remaining were not ideal for partial denture retention, an acrylic resin prosthesis was constructed to cover all of the palatal portion of the maxilla and to use the teeth merely as stabilizing agents.

The patient reported no discomfort in the region of the frenum and was able to manipulate his upper lip without any difficulty.

HAND

Barclay, L. T.: Importance of Radical Treatment in Acute Hand Injuries, *Canad. M. A. J. 56:* 142, Aug. 1946.

Barclay emphasizes the need for what was once considered radical treatment in cases of acute hand injuries in order to preserve parts which otherwise need to be sacrificed, and to help maintain function. He points out the desirability of suturing into place the small pressure dressing over the graft which is being prepared for the covering of a finger amputation stump in patients suffering from acute injury.

Earlier grafting following severe burns of the hand is advised. In a few cases if the depth of the burn can be estimated with reasonable certainty one should not wait for the period of separation of dead tissue, but should excise the necrotic tissue and undertake grafting. In severe crushing injuries of the hands, the use of primary pedicle grafts resulted in conserving portions of the hand which would otherwise have been lost.

Greeley, Paul W., Capt. M. C. USNR: Reconstruction of the Thumb. *Ann. Surg. 124:* 60, July, 1946.

In the evaluation of hand injuries, destruction of a thumb is considered to be equivalent to the loss of half of a hand. Greeley

[illegible]. To counteract this effect it is sometimes wise to "relax" the [illegible].

V. Arthroplasty

Arthroplasty of the metacarpophalangeal joints gives good results. Plaster casts are unnecessary in this procedure. One must preserve an even balance in the extensor [illegible] of the [illegible]. Arthroplasty of the phalanges are generally unsuccessful because they leave unstable joints. When necessary damaged joints can be fused at a [illegible] 45 degrees.

VI. [illegible]

These may be [illegible]. Fixation [illegible] by use of Kirschner wires [illegible].

VII. [illegible]

This can be used in Volkmann's ischemic contracture to obtain sufficient tendon length.

MISCELLANEA

Pack, G. T.: The Treatment of Cutaneous Epithelioma. Arch. Dermat. & Syph. 53: 575, June, 1946.

Pack believes that it is impossible to sterilize metastatic epidermoid carcinoma in lymph nodes by high voltage irradiation alone. For curative attempts high voltage roentgen ray therapy should be supplemented by interstitial irradiation or radical surgical dissection.

A cancer in close proximity to bone or cartilage should be treated by surgical intervention as heavy irradiation may cause a perichondritis, periostitis or osteitis. Surgical excision of epitheliomas involving the eyelids, nose, ear, external meatus and penis may sacrifice organs and tissues which are difficult to restore by plastic reconstruction.

Paget's disease should be treated as carcinoma of the breast, by amputation.

Arsenical [illegible] requires wide surgical excision followed by grafting.

In [illegible] wide surgical excision should be done, with plastic repair.

In the treatment of [illegible] cancer, the current trend is wide surgical excision followed by grafting.

Cancer in [illegible] requires wide excision and grafting.

Cancer in [illegible] scars should be treated by wide excision and grafting. [illegible]

[illegible] The primary cancer should be treated by surgical excision or irradiation. When [illegible] of the [illegible].

Webster, J. R.: Cutaneous Cancer from the Surgeon's Point of View. Arch. Dermat. & Syph. 53: [illegible], June, 1946.

According to Webster [illegible] the treatment of cancer. [illegible] the treatment is inadequate and [illegible]. If [illegible] is carried to a [illegible], the disease, [illegible].

There [illegible] of the disease [illegible] of the specimen. [illegible] The [illegible] may show that dissection of the regional nodes is advisable. Irradiation is preferred in small lesions such as on the tip of the nose. Irradiation of the external ear may cause chondritis. The lesion should be completely eradicated at the first treatment. If the first irradiation is not successful, the lesion should be excised.

The surgeon who has the principles of plastic repair in his armamentarium is a safer operator than the surgeon who lacks this knowledge.

Gordon, S.: The Role of Cancellous Bone in Plastic Surgery. Surgery 20: 202, Aug. 1946.

The author reports his experiences with cancellous chip bone grafts. The chips must be in adequate contact with living bone freed of periosteum.

qualitatively, and the food and protein requirements should be well above normal Supplementary feeding by stomach tube or parenteral therapy with plasma, blood and amino acids may be necessary High vitamin intake is also indicated Chemotherapy is given intensively for the first few days, sulfadiazine and penicillin being used After that it is used only for acute episodes of infection and for preoperative and post operative infection

Webster and Rowland recommend the use of "stamp grafts" or "small deep grafts" as temporary grafts for wound closure This procedure results in rapid wound healing Later radical resection of all scar tissue and replacement with pliable elastic skin are carried out

The technique of late skin grafting on the burned dorsum of the hand consists of

(1) Careful preparation the night before operation

(2) General anesthesia is the usual practice but local can be used

(3) A blood pressure cuff tourniquet about the upper arm is always used

(4) The amount of skin to be needed is estimated and removed by dermatome

(5) Dissect the dorsal scar (a) Outline the scar with an incision about its circumference but do not cross a flexion crease at the wrist or finger joints at right angles (b) Overcorrect web divisions (c) Resect the entire scar mass

(6) Remove the tourniquet, clamp, and tie bleeding points with fine silk or cotton

(7) Elevate the arm for a few minutes and re inflate the tourniquet

(8) Suture the graft in place with edge to edge approximation-pressure dressings and splint Leave the finger tips exposed from the dressing to check on circulation

(9) Remove the tourniquet

When the burn has been deeper and tendons or bones have been destroyed, a pedicle flap of skin and fat must be applied A direct flap from the abdomen is the best method New tendons can be grafted beneath such pedicle flaps

Snedecor, Spencer T., Lt. Col.: Bone Surgery of the Hand. *Am J Surg*, 72 363, Sept 1946

Before any surgery is begun on the hand, as advised by Snedecor, a careful evaluation of its prospective function must be made A finger without sensation is a useless prospect unless nerves can be restored, as is a finger without tendon action Surgery of the bones cannot be done through scar tissue Good skin and subcutaneous tissue must be provided Bone work usually follows skin grafting, but nerve grafts, or neurolysis, may be performed at the same time

I Thumb

(a) If just two phalanges are gone, the web between the first and second metacarpals can be deepened, forming a digit of the first metacarpal and thenar tissues

(b) When the first metacarpal is gone a bone graft may be used to replace it, being set into the greater multangulum

(c) Loss of opposition action of the thumb may be treated by ostectomy at the base of the first metacarpal and by rotations of the shaft if flexor muscles and extensor muscles are intact

(d) Dislocation of the base of the first metacarpal was not uncommon in the Army. This should be reduced without difficulty and then held in place by a Kirschner wire for 5 to 6 weeks

II Metacarpals

Mal-union of metacarpal fractures in dorsal angulation throws the intrinsic muscle mechanism of the hand out of gear It results in severe extension contracture of the metacarpophalangeal joints Correction of the malalignment is worth while, but capsulectomy is often necessary as well The heads of the metacarpals are held by a Kirschner wire, and the joint is held in 90 degree flexion for 3 weeks Lateral angulation of the metacarpals must also be corrected

III. Bone Grafts

These are used for non-union with loss of substance of a metacarpal The closer to normal length the metacarpals are restored, the better is the ultimate function of the hand

IV. Transfer of Metacarpals

Many times the loss of one finger has an adverse effect on the intrinsic muscle mecha-

TOTAL EAR RECONSTRUCTION

Preliminary Report*

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A procedure based upon the existing methods for the construction of a new ear is presented herewith. It is an incomplete report, in as much as none of the six cases in the process of reconstruction is finished. The purpose of this presentation is to share in the common effort to crystallize a satisfactory procedure for the difficult task of constructing a new ear. Particular emphasis is placed in this procedure on building a new ear as nearly a match to the normal ear of the *patient* as possible. Special consideration is given to the stability, size, contour, and protrusion of the auricle, depth and circumference of the concha, and other details.

In order to work with more exactness, a model ear of acrylic is prepared in every case. Photographs and moulages are first made of the normal and rudimentary ears. Photographs include each profile, front, and back views. A mirror image of the moulage of the normal ear is then made of clay or plastolin. From this the acrylic replica is prepared (fig. 1). (Dental laboratories are equipped to work with acrylic.) This can be sterilized in alcohol and used during the operation as a model.

When an ear is constructed, the new pinna is usually interpreted as it is in normal anatomy: namely a thin, shell-like structure. While it is an anatomical fact that the normal ear cartilage is a thin shell with protrusions and depressions on its surface, (fig. 2 A) for reconstruction purposes it is more expedient to give a different architectural interpretation. The normal ear cartilage, with its extension for the external meatus, about eight mm. in length, is set in the surrounding tissues like a funnel in the neck of a bottle. It is "firmly attached to the circumference of the auditory process of the temporal bone." Furthermore, it is anchored by ligaments and muscles, like a tree by its guy-wires. Besides, the thin shell is reinforced within by strong bands of intrinsic ligaments and muscles. This is sufficient to explain how this frail organ can maintain its shape and position in such an exposed location. Needless to say, a similarly complicated structure cannot be duplicated by surgery. We must be satisfied with a fair simulation of the aesthetic effect.

The deep, spacious concha, in our opinion, is one of the most important features in creating a normal-looking ear. The exact surgical duplication of the delicate contours of the helix, antihelix, crura, tragus, and antitragus is too difficult, if not impossible as yet, but the proper depth of the concha will, for the average observer, compensate for much of the lack in finer contours as long as the dimensions and protrusion of the constructed ear are correct.

* Paper read at annual meeting of The American Society of Plastic and Reconstructive Surgery, November 16, 1946.

Gordon has used this method in repairing small skull defects, in hands, in malar defects, and in defects about the orbit; but its largest field of usefulness has been in the repair of non-union of fractures of the mandible. Sixty-one cases are analyzed; the largest defect in the series being $1\frac{1}{2}$ inches. In only one case the result was not satisfactory. Union occurred in this case at one end only. The time required for union varied from 28 days for small defects to 6 to 8 weeks for large defects.

A series of 12 cases in which the grafts were inserted into infected or recently infected areas with but one failure is cited as proof that these grafts do well in spite of the presence of contaminating or infecting organisms.

Andreae, W. A., and Browne, J. S. L.: Ascorbic Acid Metabolism After Trauma in Man. *Canad. M. A. J. 55:* 425, Nov. 1946.

Andreae and Browne report 14 cases of fractures and 7 cases of burns which were studied in relation to their intake and output and blood levels of vitamin C.

The results indicated that the ascorbic acid retention was tremendously increased following damage and that the administration of very large doses of ascorbic acid was probably necessary in this period.

model of the cartilage. The inner surface of the case represents the negative form of the ear cartilage. Many small perforations are made in the wall of the acrylic mold to allow for adequate blood supply. Sufficient rib cartilage is resected to fill up the acrylic case. Stimulated by Peer's method of using "diced" cartilage for ear reconstruction, the cartilage is cut up in small pieces, although not necessarily in dices. It is thought to be preferable, for this purpose, to cut the cartilage into flat chips and thin platelets. It is expected that after healing they will offer a laminated structure similar to plywood and therefore perhaps be more resistant and stronger than the small square dices.

After the acrylic case is tightly filled with cartilage, the cover is secured over it with silk or wire. It is then buried under the skin of the chest (fig. 4 A).

FIG 3

A. Moulage of normal ear.
B. Acrylic model of proposed new ear prepared from mirror picture of normal ear.
C. Acrylic shell. Inner surface represents negative of new ear cartilage. Perforations permit blood and serum to enter into shell to nourish cartilage chips

We are not certain of the optimum time for firm cohesion of the cartilage pieces, but would recommend, for the time being, that it be left buried for at least six months (fig. 4 B and C). (We have one patient who had an acrylic mold buried under the skin of the chest for eight and one-half months. This long period of time was allowed because the patient developed thrombosis in the right femoral vein and infarcts in both lungs following the rib resection.)

In the other procedure, two or three rib cartilages from among the sixth to the ninth ribs were pieced together. The natural curvature of these cartilages roughly lends itself to imitation of the contours of the ear. The broad surfaces are planed down to fit each other. They are then tied in a block with stainless steel wire or silk and transplanted under the skin of the chest. The block is left there for a period of at least four months, during which time a fairly firm fibrous capsule develops about it. Whether molded cartilage or a solid cartilage block is used, the following steps are grossly the same:

Instead of a shell, for reconstructive purposes, the pinna is considered as a massive, semi-circular body (fig. 2 B). The semi-circular shape provides a broad base and assures stability. In the center, like the hole in a doughnut, is the concha. The base of the concha should not contain cartilage. This enhances the depth, and is an aid to the stability of the new ear. The thickness of the

FIG. 1. Moulages of Normal and Rudimentary Ears. In the Center, Acrylic Mirror Model of Normal Ear

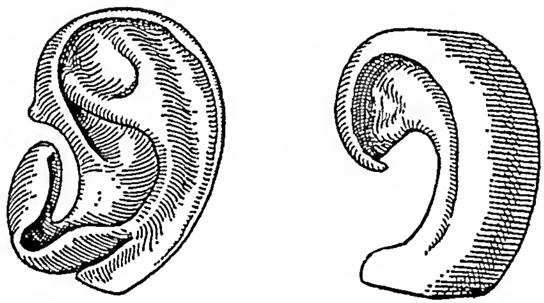


FIG. 2

A. Normal ear cartilage. (Spalteholz)
B. Diagram of the ear cartilage block used for reconstruction. (Three-quarter view) The thickness of the cartilage represents (and varies) according to the protrusion of the ear. There is no cartilage at the base of the concha.

cartilage block, which is at a right angle to the skull, represents and varies according to the protrusion of the ear.

In order to provide such a cartilage block, we have employed two different procedures. The one was to prepare a mold in the form of an acrylic case (fig. 3) made in accordance with a revision of the mirror model of the normal ear. In this alteration, allowance is made for the thickness of the skin in preparing the

A post-auricular flap is prepared. Formerly, only the hairless post-auricular skin was used for this purpose. However, we found that this is not sufficient to cover the configurations of the ear. Therefore a certain amount of the scalp is also utilized. Measurements of the skin surface are taken from the acrylic

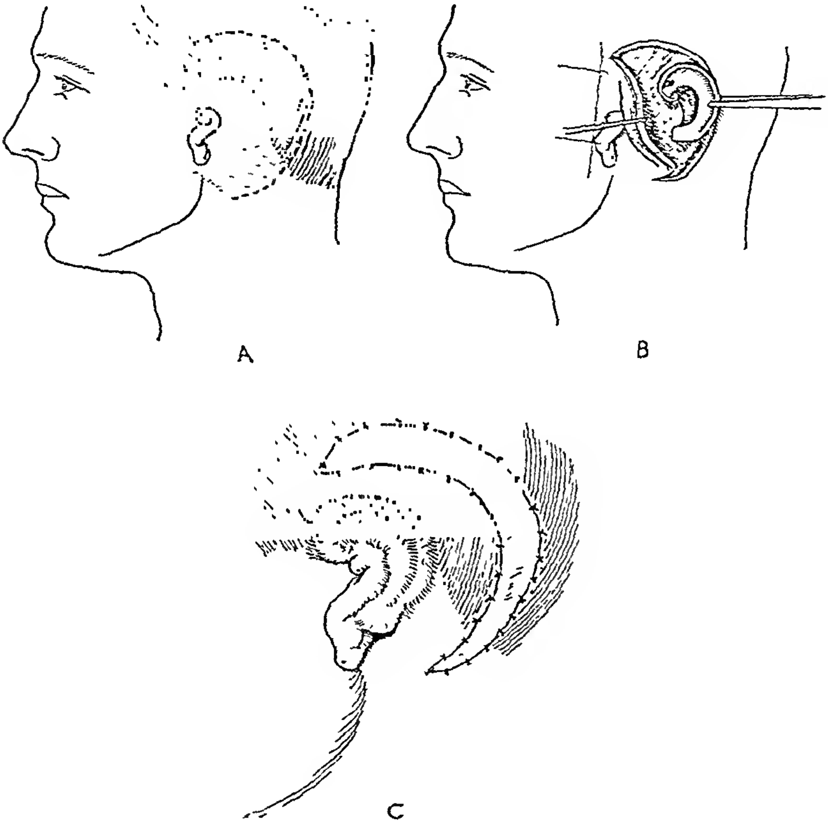
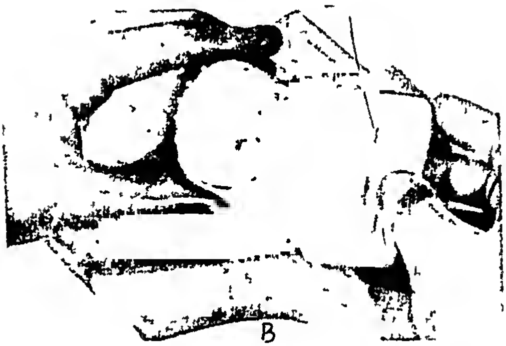


Fig. 5

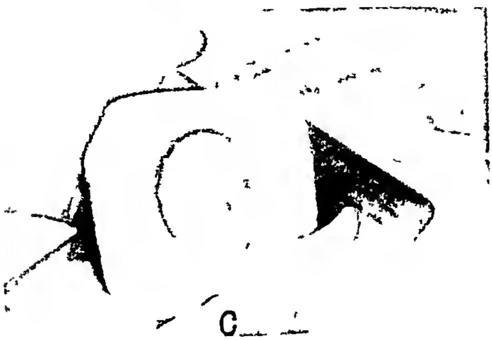
A. Dotted line indicates semi-circular incision in scalp to raise large flap.
B. Molded ear cartilage placed under post-auricular flap.
C. Ear cartilage block *in situ* under flap. Gap in scalp covered with Thiersch graft. Upper portion of the ear is covered with hairy scalp. Hair is subsequently removed either by electrolysis or surgical resection of follicles. (Rethy's method).

model with the aid of a thread, commencing at the tragus, closely following the depth of the concha and contours of the anithelix, scapha, helix, and finally, the cranial surface of the ear. (The skin allowed for the cranial surface does not have to be measured exactly, because eventually it will be replaced with a free graft. Furthermore, the cartilage block temporarily has a straight back, for it is easier to drape the skin flap around it.) One will be amazed at the

A



B



C

Fig 4

A. Acrylic shell filled with cartilage chips implanted under skin of chest.

B. and C Molded ear cartilage after being implanted in acrylic case under skin of chest for eight and one-half months It is solid and flexible Notice feeding pedicles on surface of cartilage which grew through the perforations of the acrylic case. Thin cartilage base of concha will be excised before transplanting it under post-auricular skin flap

the defect temporarily (figs. 5 C and 6). Silkworm gut is used as drain to prevent hematoma formation under the flap.

In about four to six weeks, the concha is prepared. With an incision, according to the configuration of the rudimentary ear, its cartilaginous elements are removed and the skin covering is inverted to form the lining of the new concha. (Some skin and cartilage may be spared for the purpose of forming a new tragus.) It is emphasized again that the dimensions of the concha must be exaggerated to allow for the thickness of the skin, scar formation, and contracture (fig. 7 B and C). Usually additional skin graft is necessary to line the concha. Pressure over the skin graft is employed by packing tape, or a stent mold. The first dressing is done after twelve to fourteen days and the concha

FIG. 6. CARTILAGE BLOCK TRANSPLANTED UNDER SKIN-SCALP FLAP. NOTICE RUDIMENTARY EAR TEMPORARILY IN ORIGINAL POSITION WITHIN DEPRESSION INDICATING CONCHA

is repacked with gauze or with the stent mold for an additional few weeks to counteract any tendency to contracture.

Four to six weeks later the cranial surface of the ear is prepared (fig. 8 A and B). The periphery of the ear is marked according to the acrylic ear. It is advisable to leave ample skin overlapping beyond the ear cartilage. We attempted, in one instance, to leave so much skin overlapping that it could be utilized for the construction of the new helix. It looked promising for a while, but eventually shrank to the edge of the new ear and practically disappeared. Perhaps if cartilage support is provided, the shrinkage can be prevented. The cranial surface of the ear is now carved according to the acrylic ear. But it should not be as deep, lest the stability of the new ear be jeopardized. The denuded cranial surface of the ear and the skin defect on the mastoid area are covered with a one-piece Dermatome graft of fair thickness in as much as the quality

amount of skin required to cover the tortuous surfaces of an ear. It is advisable to be generous with the flap to allow for its contracture. In spite of the large flap, some additional skin has to be provided for the lining of the concha, for the helix, and for the cranial surface of the ear.

The large skin-scalp flap is prepared with a crescent-shaped incision (fig. 5 A). The skin is elevated to a carefully established line, corresponding with the anterior edge of the ear. The flap should be delayed once. If it is very large, it may be raised in two sections.

Usually on the site of the congenitally absent ear there is a rudimentary ear containing crumpled ear cartilages and the ear lobe. This rudimentary ear should not be discarded because its skin can be well utilized later, when forming the new concha. Naturally, the earlobe will be utilized in its entirety.

After the blood supply of the flap is assured, the molded cartilage ear or cartilage block is transplanted under it (fig. 5 B). At this point, accuracy cannot be over-emphasized. Before shaping the patient's head for the operation. the location of the ear on the normal side should be carefully studied. Particular consideration should be given to its relation to the hairline. The site of the new ear should be projected as accurately as possible on the skin, and *marked first with Mercurochrome and afterward with superficial scratches* with the back of the knife. The anterior, upper, and lower borders of the ear should be marked.

Unfortunately, a marked facial asymmetry, and sometimes facial palsy, is often associated with the congenital defect. The upper and lower jaws, in fact the whole visceral skull may be underdeveloped on the affected side. The ear lobe is sometimes lower or higher than on the normal side. One often has to compromise in placing the new ear according to the condition of its environment. The misplaced ear lobe occasionally can be moved slightly up or down with simple operative measures.

The cartilaginous ear is carefully anchored in its proper location with several sutures. The hole representing the concha has to be carved out from the cartilage, if not already prepared. This will permit the skin flap to follow the depth of the concha; it will also allow the rudimentary ear cartilage bundle to remain in place temporarily (fig. 6). All depressions should be exaggerated, allowing for the thickness of the skin, scar formation, and subsequent skin contracture. The contours and measurement of the sterile acrylic ear model are carefully followed during the operation.

In order that the skin flap may more readily follow the contours of the cartilage, the circular skin flap can be divided by radial incisions into sectors. There are so many possibilities and variations in the details that is is wiser to leave them to the ingenuity of the surgeon to solve as they present themselves rather than to lay down definite patterns. The skin flap may be tacked down with a few sutures into the deep points such as the base of the concha and intercrural depression. The blood supply of the flap is carefully guarded. When the cartilage is draped with the skin-scalp flap, the scalp incision will present a gap which cannot be closed by suturing. A Thiersch graft is used to cover

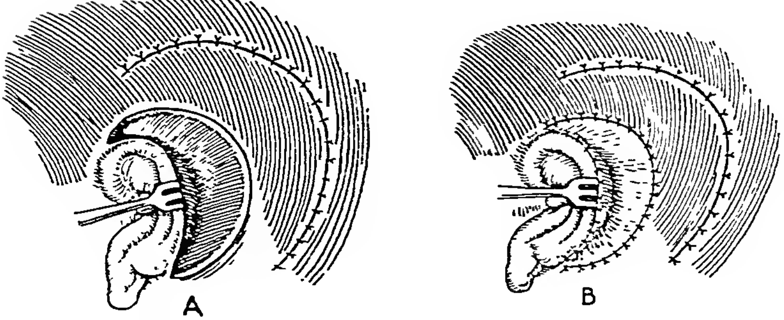


FIG. 8

A. Cranial surface of ear prepared. The Thiersch graft excised, the scalp is slid back to its former position.

B. Cranial surface of ear and defect in post-auricular region covered with a thick Dermatome graft. Defect in scalp closed.

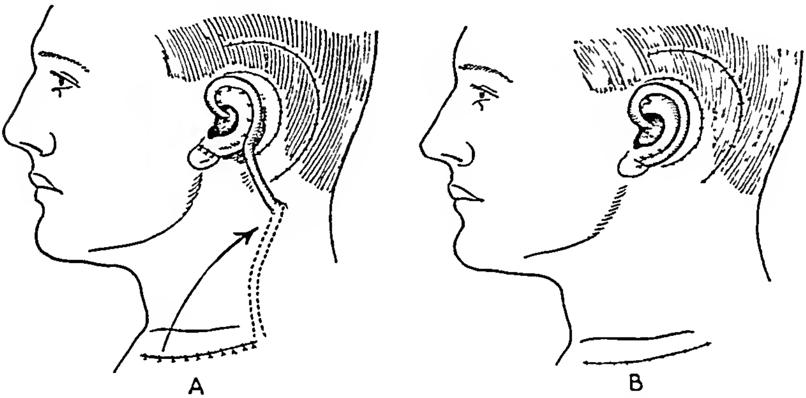


FIG. 9

A. Thin skin tube from clavicular region has been moved up to ear. Part of it is attached to form helix. (Pierce's method) Ear lobe of rudimentary ear attached. Scars behind ear represent edge of Dermatome graft and closure of incision for original post-auricular skin-scalp flap.

B. Diagram of reconstructed ear. Balance of skin tube attached to form helix.

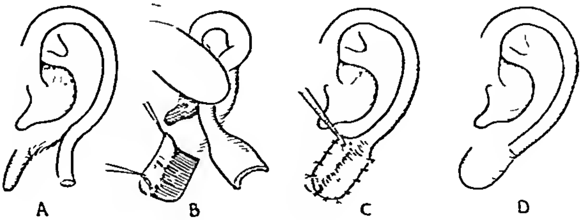


FIG. 10

A. Diagram of a reconstructed ear with a narrow rudimentary ear lobe. Skin tube already attached to form helix.

B. A flap is raised and unfolded from the posterior surface of the rudimentary ear lobe. End of skin tube spread ready to cover defect on back of enlarged ear lobe.

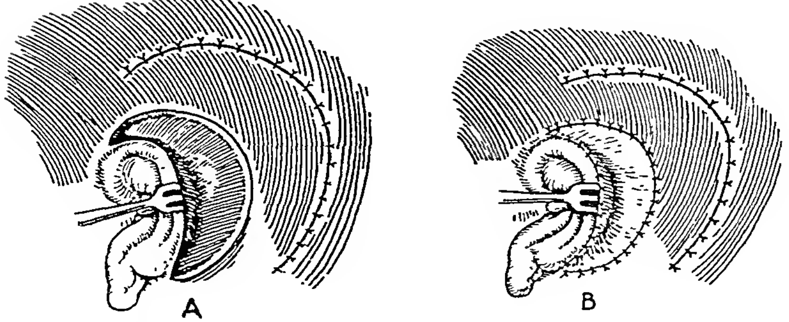
C. End of skin tube sutured to posterior surface of enlarged ear lobe.

D. Diagram of reconstructed ear.

FIG. 7

A. Patient before operation with rudimentary right ear
B. AND C. Photographs showing large deep concha and tragus Ear lobe attached Cranial surface of ear not prepared yet, nor is helix attached

of the skin here is cosmetically rather important. It is grafted by means of the Esser Inlay on a stent. The Thiersch covered area in the scalp is excised and the skin edges approximated after some undermining and shifting. After



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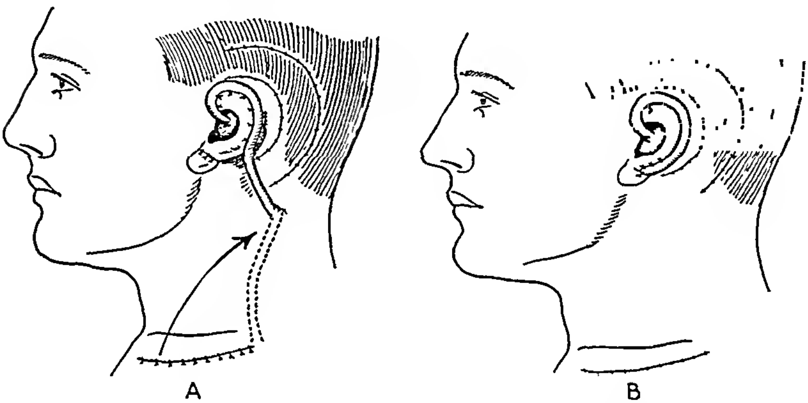

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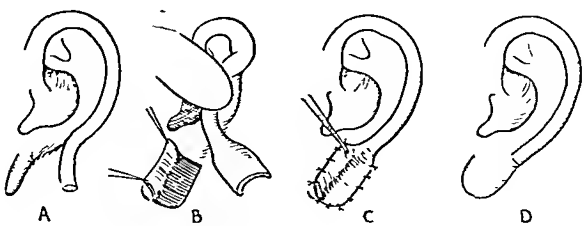

Fig. 10

A. Diagram of a reconstructed ear with a narrow rudimentary ear lobe. Skin tube already attached to form helix.

B. A flap is raised and unfolded from the posterior surface of the rudimentary ear lobe. End of skin tube spread ready to cover defect on back of enlarged ear lobe.

C. End of skin tube sutured to posterior surface of enlarged ear lobe.

D. Diagram of reconstructed ear.

the back of the ear is lined, the ear lobe is attached to the new pinna (fig. 9 A). If the ear lobe is narrower than that of the normal side, it can be enlarged by unfolding a flap from the posterior surface of the lobe. The defect is lined by the end of the skin tube used for the helix (fig. 10).

At this point, it should be mentioned that part of the new pinna is usually covered with hairy scalp. The hair is epilated either by electrolysis or surgical resection of the follicles according to Rethy's method. The other alternative is to eventually remove the hairy skin altogether and replace it with a skin graft. At present we are unable to offer a definite recommendation as to which method is the more advantageous.

Now only the attachment of the new helix remains. A clavicular skin tube (according to Pierce's method) has been prepared and step by step moved up to the ear (fig. 9 A and B).

These are the main steps, roughly described. There are many small details and aesthetic refinements which the surgeon must solve according to their presentation.

SUMMARY

A certain architectural interpretation is offered for the construction of a new ear. The individual ear is made by closely following an ear model prepared of acrylic after the normal ear. The ear cartilage is interpreted not as a shell, but as a semi-circular body. For this purpose, either a cartilage mold or a massive cartilage block is used. Cartilage cut up into chips and platelets is placed in an acrylic form, individually prepared for each patient. The cartilage chips and platelets, after healing together by connective tissue offer a certain resistance due to the laminated effect. A deep, full-sized concha with possible indication of the auditory canal, the base of which is not cartilage but skin, is very important from the aesthetic point of view. The skin of the rudimentary ear is utilized for lining the concha. A large post-auricular skin-scalp flap is used, allowing the skin to follow the extensive, tortuous surfaces of the new ear. A narrow rudimentary ear lobe is enlarged by raising a flap from its posterior surface and covering the wound surface with the end of the skin tube used for the helix.

ESTLANDER-ABBE OPERATION IN TREATING SECONDARY HARELIP DEFORMITIES AND DEFECTS OF THE UPPER LIP RESULTING FROM CANCER

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In the last few years many advances have been made in the treatment of cleft palate patients. With the improvement in surgical technique the patient as well as the surgeon has become more critical of the final result. We all aim toward a greater refinement and perfection in the end result though it is not always attained. The purpose of this paper is to call attention to certain problems associated with secondary deformities in cleft palate cases. These deformities are not apparent in infants and young children; but as they grow older, certain changes take place in the nose, lips, and jaws. By the time the child becomes an adult, the deformity may be quite marked.

The outstanding secondary deformity is usually seen involving the upper lip. Even in lips which have been carefully repaired at the initial operation in infancy, unevenness of the vermilion border may develop as the patient matures; and the contour of the upper lip may be distorted to such an extent that the normal outline of the cupid's bow is lost. If the upper lip shows lack of development or tenseness, the lower lip becomes overdeveloped to compensate for the defect of the upper. As harelip and cleft palate patients grow older they may develop nasal deformities, the most typical being distortion of the nostril at the site of the original cleft. The nasal septum may be badly distorted blocking aeration on the affected side. In bilateral clefts the shortness of the columella often causes a broad, flat nasal tip. When family and racial characteristics manifested in the development of the nose are added to the existing deformity it is easy to realize the variety and extent of the problems with which the surgeon has to cope.

If we examine the mouths of patients with cleft palates we may find many striking departures from the normal, the most important of which is the underdevelopment and distortion of the maxillary bones. This serious secondary deformity is due to the lack of growth of the maxilla, and it affects the contour of the upper lip as well as the lower part of the nose. As a matter of observation, this underdevelopment of the maxillary bones is more marked and more common in those patients who have been subjected to operative treatment in childhood than in the non-operated cases. The reason for this should be a matter of serious study. Is it because operative treatment causes damage to the blood supply of the maxillary bones or does the cicatricial tissue following surgery cause a delay in the proper expansion and growth of the palate? Whatever the cause, the treatment of the resulting deformities requires great attention.

The underdeveloped maxilla with irregularities of the upper teeth often becomes apparent soon after the eruption of the temporary teeth and may grow progressively worse as the child matures. If the teeth are given the benefit

of intelligent orthodontic treatment many late deformities of the teeth and jaws will be eliminated or minimized. Unfortunately, the facilities are not available for all cleft palate patients to have such treatment.

Since the publication of a paper dealing with secondary deformities in cleft palate patients* where various phases of treatment were discussed, I have treated many adults with secondary deformities and would like to supplement my previous paper with a series of fifty cases that have been treated since that time.

These cases vary in extent, the mildest ones presenting only a somewhat tense and retracted upper lip, especially along the vertical scar line, but with well developed maxillary arches. The extreme cases present definite loss of normal upper lip tissue with ugly, adherent scars and combined with marked retraction of the alveolar processes and loss of many teeth. Between these two extremes there are many variations.

When the patient presents himself for treatment whether he is in the mild or extensive category, the first step is to make a careful examination and study of his dental apparatus. As the teeth are part of the framework for the upper lip they must be adequate, or else any operative measures will not be sufficient. In some cases it may be necessary to refer the patient to an orthodontist for regulation of the teeth. If there is poor and neglected dentition with underdevelopment of the maxilla and retraction of the upper lip, the problem becomes more complicated. The procedure then is to remove all the decayed and misplaced teeth and try to save any that may be used later to act as a support for a prosthesis.

The second step, usually necessary, is to constuct a denture with the proper fullness to act as a framework or support for the upper lip, as well as for mastication. Such dentures may be supplied with an obturator in cases where there is a palatal defect that cannot be adequately restored by surgery.

Once the framework of the upper lip (either temporary or permanent) is supplied, the next procedure is to operate and transfer a section of the lower lip to the upper, because in all of these cases there is overdevelopment of the lower lip. By such a transfer the contour of the lower lip as well as that of the upper lip is improved.

HISTORICAL NOTE

Utilization of part of either lip to repair a defect of the other lip has been an established procedure done by plastic surgeons for many years. Estlander† in 1872 shifted a section of the lateral portion of the upper lip to a defect of the lower lip utilizing the coronary arteries.

Robert Abbe‡ in 1895 was the first to consider the idea of inserting a pedunculated flap from the lower lip to give greater length to the upper lip and at the same time to reduce the size of the lower lip in harelip patients.

* "Secondary Deformities in Cleft Palate Patients." Annals of Surgery, Vol. 109, No. 3, March, 1939, V. H. Kazanjian, M.D.

† Estlander, J. A. Methode d'Autoplastie de la Joue ou d'une Levre. Rev. mens. de med. et chir., Par. 1: 344, 1877

‡ Abbe, R. A New Plastic Operation for the Relief of Deformity Due to Double Harelip. M. Rec., 53: 477, 1898

Since then these procedures with various modifications have been used quite freely. However, it is a fact that, although the Abbe procedure was published in 1895, its potentialities were not realized until the last few years. Therefore, it is felt that it may be advisable to outline the indications, operative procedure, and modifications of the Abbe operation as gained from experience in a series of fifty cases treated since 1939.

The Estlander-Abbe operation is indicated in all cases where there is retraction and underdevelopment of the upper lip, or in cases where a defect of the upper lip has been caused by surgical removal of malignant tumors. It is equally applicable in unilateral as well as bilateral harelips, although in each case the procedure is modified to meet the existing condition.

OPERATIVE PROCEDURE

In performing this operation a local anesthesia is preferred, but there is no contraindication to the use of ether anesthesia through a nasal intratracheal tube. The drawback to general anesthesia is the likelihood of postoperative nausea and vomiting. To minimize these, measures such as intravenous fluid therapy following operation, mild sedatives and so forth must be taken. If the patient becomes nauseated and vomits while the upper and lower lips are joined together there is sufficient space at each corner of the mouth to expel the vomitus.

For local anesthesia 2 cc. of 2% novocaine with 1:50,000 epinephrin are injected into each infraorbital canal with a fine needle piercing the skin of the face at a point one half inch lateral to the ala of the nose. The direction of the needle is upward and toward the opening of the infraorbital canal. Usually there is no difficulty in locating this and advancing the end of the needle through it. If the canal cannot be located it may be necessary to inject more than 2 cc. of novocaine in the neighborhood of the infraorbital nerve. Usually the injection will give complete anesthesia except at the base of the columella where a few drops of novocaine are injected.

For anesthesia of the lower lip infiltration of 4 cc. of novocaine at the median section of the lower lip is carried out. However, before injecting, it is advisable to mark the outline of the flap on the skin.

OPERATION IN UNILATERAL HARELIP CASES

A through and through incision is made at the original scar line and the two halves of the upper lip separated. The scars are completely excised until each side assumes a normal position, leaving a triangular space between the two halves. The bleeding vessels are tied. The vessels of the lower lip are compressed with lip clamps or with finger pressure from the operator on one side and the assistant on the other (fig. 1). A triangular flap of the desired size is made by cutting through the entire thickness of the lip except on one side where the through and through incision is carried up only to the vermilion border. This is where the blood supply of the flap comes from the coronary arteries. It is not necessary to emphasize the fact that when the knife is approaching the vermilion border care must be taken not to cut the vessels. However, it is quite safe to cut

the skin and mucous membrane and separate the intervening soft tissues wit blunt dissection.

The lower lip defect is closed, first the mucous membrane surface with thre zero chromic catgut and then the skin with fine dermalon. The sutures con necting the vermilion border should not be deep but should grasp only the skin i order to prevent any possible damage to the coronary artery supplying the flap

The first suture of the flap to the upper lip defect connects the mucous mem brane of the apex of the triangular flap to that of the apex of the labioalveola sulcus. Suturing is carried through the free side of the flap with special care to approximate the mucocutaneous borders in a good line. Following this, the mucous membrane as well as the skin surfaces of the pedunculated flap are

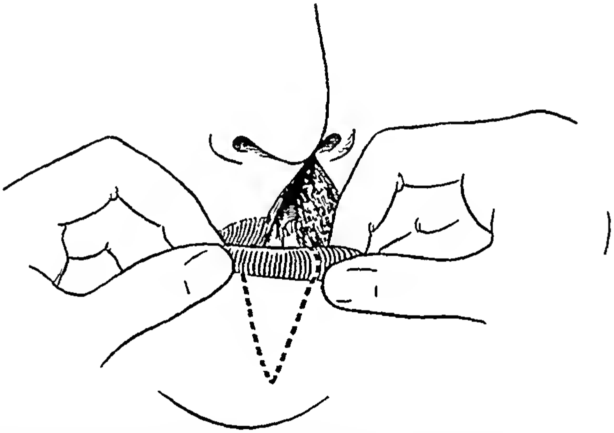

FIG. 1. Diagram to show how the vessels of the lower lip are compressed by finger pressure of the operator on one side and by the assistant on the other side, prior to cutting through the entire thickness of the lip except on one side where the through and through incision is carried up only to the vermilion border.

sutured. Here again the last suture connecting the base of the flap to the upper lip must be introduced in such a manner so as not to jeopardize the blood supply of the flap.

A pressure dressing is applied, care being taken not to block nasal breathing.

POSTOPERATIVE TREATMENT

Patients may experience difficulty in breathing because of blockage of the nasal passages or crusting of secretions within the cavity. Therefore, as a precautionary measure, two rubber tubes about one third of an inch in diameter, are introduced into the oral cavity, one on each side of the flap connecting the two lips. These are used without discomfort to the patient. The patient is given a high caloric, high protein, high vitamin content liquid diet and is fed through a tube. His weight is charted daily.

The second stage operation is performed approximately two weeks after the

first stage. The base of the flap is cut through and the upper and lower lips separated. If the patient also requires a rhinoplastic procedure, it is usually performed at this stage.

VARIATION IN THE ESTLANDER-ABBE OPERATION

In bilateral cases the prolabium is often used to raise the tip of the nose and overcome the shortness of the columella. Not infrequently the end of the flap is made long enough to actually supply skin to the columella if necessary. At other times the flap may be divided in the middle and extended on each side toward the base of the nostrils.* In one case the shape of the flap from the lower lip was actually "barrel shaped" and was divided in the middle to supply enough tissue for the upper lip (fig. 2).

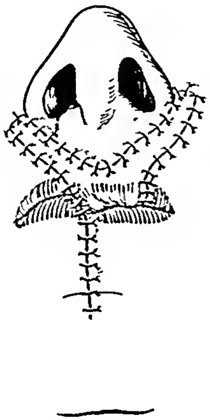

Fig. 2. Diagram showing barrel-shaped flap which has been divided in the middle and used to replace scars of the upper lip, and in the meantime utilize the median section of the ip in cases where the prominence of the tip of the nose is normal.

Not all of our cases have been done in the two stage procedure. Occasionally we have been obliged to operate the third time in order to attain a better cosmetic result. However, it is better to wait about three months in order to give the tissues of the lip time to assume a more normal condition.

CONCLUSIONS

In this paper the treatment of secondary defects in cleft palate patients and the principal types of deformities are described. These deformities are not apparent at first, but as the child grows older they become more conspicuous. Special attention is called to the underdevelopment of the upper jaw and the upper lip and the overdevelopment of the lower lip to compensate for the defect of the upper.

The general principals of treatment are outlined and it is recommended that

* Cannon, Bradford. The Use of Vermilion Bordered Flaps in Surgery About the Mouth. Surg. Gyn. and Obstetrics, Feb. 16, 1942, Vol. 74, 458–462

FIG. 3 Pre operative photographs of patient Case I This patient was the youngest in the writer's group of cases operated on by the Estlander Abbe procedure

FIG 4 Photographs of Patient Case I Taken Three Years Post operatively

the construction of an adequate framework in the form of a dental appliance be carried out to act as a support to the upper lip in addition to the Estlander-Abbe operation. The procedure of this operation is described in detail.

FIG. 5. PRE-OPERATIVE PHOTOGRAPHS OF PATIENT, CASE II

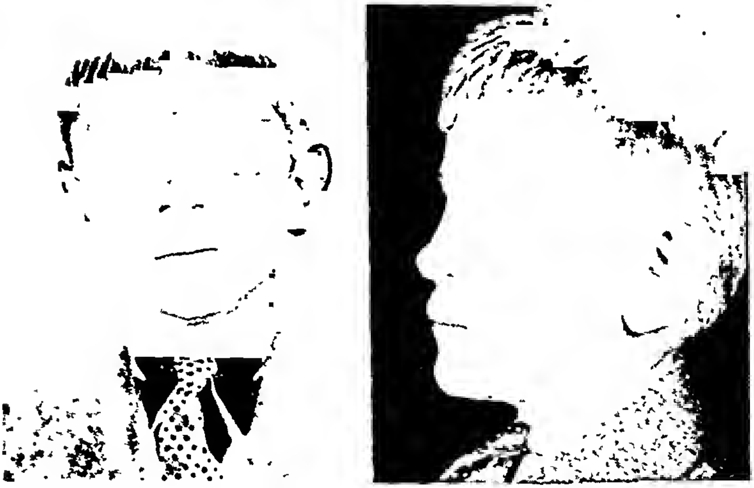

FIG. 6. POST-OPERATIVE PHOTOGRAPHS OF PATIENT, CASE II

Appreciation is expressed to Dr. Richard C. Webster for his assistance in the preparation of this paper.

Case History No. 1—J. T. This patient had had a harelip and a cleft of the soft palate which had been repaired in infancy. She had also had a repair of the perforation of the hard palate and in 1940 at the age of five years she had been started on orthodontic treatment.

When the patient was seen in 1941, at the age of five and a half years, the upper lip was tight, slightly retruded and the vermilion border was drawn up in the middle with a loss of the cupid's bow (fig. 3).

FIG. 7. PRE-OPERATIVE PHOTOGRAPHS OF PATIENT, CASE III

FIG. 8. POST-OPERATIVE PHOTOGRAPHS OF PATIENT, CASE III

On May 6, 1941 the patient was operated upon under ether anesthesia. The scar tissue was excised from the upper lip creating a defect where the lip had been split through and through. A "V" shaped flap was taken from the lower lip and swung upward into the defect of the upper lip.

On June 4, 1941 the second stage Estlander-Abbe procedure was performed. This consisted of separating the lips by cutting the pedicle. By slight trimming and adjustment of the tissues the vermilion borders were carefully approximated.

FIG. 9. Pre-operative Photographs of Patient, Case IV

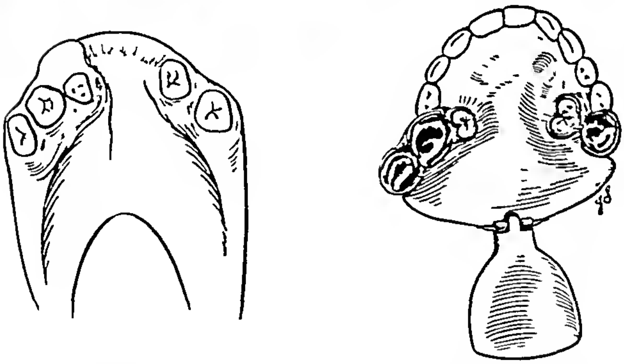

FIG. 10. Denture (Case IV) supplied with considerable fullness at the anterior part of the maxilla to give support to the upper lip To this denture an obturator was attached which covered the palatal defect.

When the patient was seen on January 10, 1944 the scar lines were smooth and hardly visible The profile was much improved and the upper lip was no longer tight or retracted (fig. 4).

Case History No. 2—R. S. This seven year old patient had been operated upon three times by another surgeon for repair of harelip and cleft palate.

Examination on June 18, 1940 showed that the patient undoubtedly had had a double hare lip and a unilateral cleft of the alveolar process and palate The central portion of the

upper lip was less developed than normal and the contour was not good The teeth and alveolar processes had developed very well, there being good occlusion except on each side

Fig 11 Post operative Photographs of Patient, Case IV

Fig 12 Pre operative photographs of patient, Case V Note the extreme retrusion of the upper lip due to retraction of the maxilla

of the fissure The lower lip was somewhat overdeveloped to compensate for the inadequacy of the upper The columella was short causing slight flattening of the tip of the nose (fig 5)

On June 5, 1941 the patient was operated on under ether anesthesia The columella was separated from the septum by an incision which was then carried down on the lip bilaterally

FIG. 13. Photograph of patient, Case V, following first stage of Estlander-Abbe operation.

FIG. 14 Post-operative photographs of patient, Case V. The upper lip is supported by a prosthetic appliance to give the necessary fullness.

to the vermilion border. The scar on the lip was excised and a through and through incision was made splitting the upper lip. This caused a considerable defect as the tissues retracted. A "V" shaped flap was then taken from the lower lip and rotated into this defect. The

FIG 15 Pre operative Photographs of Patient, Case VI

FIG 16 Photograph of patient, Case VI, following first stage of Estlander-Abbe operation

columella and the lip tissue attached to it were advanced on the septum before the rotation of the lower lip flap into the upper lip defect

On June 16, 1941 under ether anesthesia, a routine second stage Estlander Abbe procedure was performed

When the patient was last seen on June 15, 1942 there was marked improvement in the contour of the lips (Fig. 6). His speech was good and physiologically the child was essentially normal. Prior to operations he had been rather sensitive, particularly in school.

FIG. 17. POST-OPERATIVE PHOTOGRAPHS OF PATIENT, CASE VI

FIG. 18. PRE-OPERATIVE PHOTOGRAPHS OF PATIENT, CASE VII

Case History No. 3—M. G. This nine and a half year old patient evidently had a partial double harelip which had heen repaired in childhood.

Examination on May 1, 1942 showed the upper lip to be quite short medially and the lower lip was becoming overdeveloped. It was decided to wait until the patient was older before operating, fig. 7.

On June 20, 1945 an operation was performed under ether anesthesia. The scar lines on the upper lip were excised and the medial part isolated and raised, thus giving more promi-

FIG. 19. Post-operative Photographs of Patient, Case VII

FIG. 20. Pre-operative photographs of patient, Case VIII. Note marked distortion and retraction of upper lip with prominent nasal hump and retracted nasal tip due to shortness of the columella.

nence to the tip of the nose. A flap was taken from the middle of the lower lip and rotated upward to fill the defect in the upper lip. This required suturing of the flap superiorly to the medial part of the upper lip and on each side to the lateral parts of the upper lip

On July 2, 1945 under ether anesthesia the pedicle of the flap was cut through and the lips separated.

When the patient reported for a check up on January 31, 1946 the upper lip was found to be full and flexible, fig. 8.

Case History No. 4—H. I. This sixteen year old patient had a harelip and cleft palate and gave a history of having had fourteen operations in childhood.

Examination at patient's first visit showed marked retrusion and tightness of the upper lip with overdevelopment of the lower lip. The anterior part of the upper jaw was underdeveloped (fig. 9).

On February 8, 1945 under ether anesthesia a routine first stage Estlander-Abbe operation was performed.

The second stage Estlander-Abbe procedure was carried out thirteen days later, under local anesthesia.

Fig. 21. Photographs of patient, Case VIII, showing marked retraction of the upper jaw and palatal defect. It was necessary to remove some of the teeth and bone in the region of the premaxillary process in order to make the upper jaw suitable for the reception of a denture.

Following the lip operations a denture was made which brought the lip forward and provided normal appearing teeth anteriorly. To this denture was attached an obturator which covered the palatal defect (fig. 10).

When patient was seen on March 5, 1947 there was considerable improvement in the contour of the lip and the scars were almost invisible except for a slight prominence of the transplanted flap near the vermilion border (fig. 11).

Case History No. 5—C. D. This twenty year old patient had had three operations in childhood for the repair of cleft palate and harelip.

My examination on July 9, 1942 showed a perforation of the palate near the uvula about five centimeters in diameter. The upper lip was short, tight and retracted. The nose showed a drooping tip and a columella which was slightly short (fig. 12).

On August 21, 1942 an operation was performed under local anesthesia, and a routine first stage Estlander-Abbe procedure carried out. Fig. 13 shows the lips joined together by the flap after this operation.

On September 8, 1942 the second stage Estlander-Abbe operation was performed under local anesthesia. Intra-vestibular incisions were then made and the skin undermined over

the framework of the nose. The tip of the septum was exposed and shortened and some cartilage was removed from the dorsum. The alae were trimmed liberally until a good contour was obtained.

A denture was made to improve the contour of the upper lip and to cover the perforation of the hard palate.

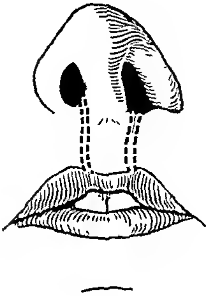

FIG. 22

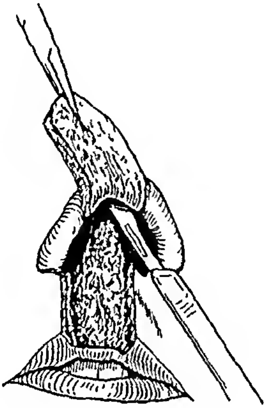

FIG. 23

FIG. 24

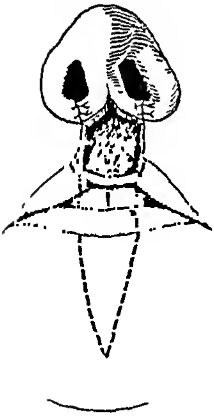

FIG. 25

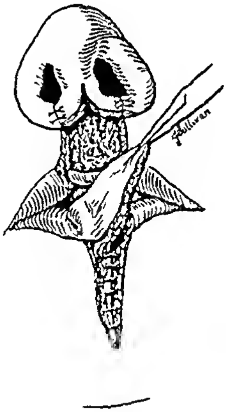

FIG. 26

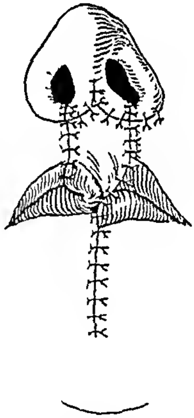

FIG. 27

FIGS. 22, 23, 24, 25, 26, 27. Diagrams showing the various stages of operation for the elevation of the tip of the nose to improve the contour of the nostrils and for the transfer of a triangular flap from the lower lip to the upper lip.

On July 14, 1943 an operation was performed under local anesthesia and the small perforation of the palate was closed without difficulty. The anterior part of the septum was freed up and brought to the midline. Further trimming of the alar cartilages was also carried out.

When the patient was seen on February 1, 1944 his general appearance had greatly improved, fig. 14. His speech was almost normal.

Case History No. 6—R. F. This eighteen year old patient had several operations in childhood for repair of harelip and cleft palate.

Examination on July 22, 1943 revealed a high palatal arch. The upper lip was short and tight and there was a marked notch of the vermilion border. An attempt evidently had been made to elongate the soft palate by utilizing the lateral pharyngeal tissues and as a result there was a tube like opening to the nasopharynx. The nose was over sized, the dorsum showed a slight prominence and a curve to the right, and the tip drooped because of the upward retraction of the columella (fig. 15).

On October 1, 1943 under ether anesthesia a routine first stage Estlander-Abbe operation was performed (fig. 16).

On October 22, 1943 the second stage Estlander-Abbe procedure was carried out and also a routine nasal plastic operation.

FIG. 28. Post-operative photographs of patient, Case VIII. The excess tissue at the columella requires further attention.

Four months after the above operations a denture was made which added to the improvement of the contour of the upper lip.

On April 21, 1944 an operation was performed under local anesthesia and the redundant tissue on the left side of the upper lip was excised.

On December 8, 1944 under ether anesthesia a "push-back" operation on the palate was performed. The vermilion border of the upper lip was also improved slightly at this time.

When the patient was seen on January 2, 1946 the contour of the nose and the upper lip showed considerable improvement, although there was still slight fullness on the left side of the upper lip (fig. 17).

Case History No. 7—W. L. This nineteen year old patient had had a left sided harelip which had been repaired in childhood. The palate was normal.

Examination showed a retracted, tight upper lip and an overdeveloped lower lip. The left side of the nose was slightly distorted and there was a mild deviation of the septum (fig. 18).

On March 27, 1943 the patient was operated on under local anesthesia. The scar tissue of the upper lip was excised and the defect thus created filled with a flap from the lower lip.

On April 14, 1943 a routine second stage Estlander-Abbe procedure was carried out under local anesthesia. The contour of the left ala was also improved at this time.

On May 5, 1943 an operation was carried out under local anesthesia and a slight adjustment of the tissues of the upper lip was made to correct a prominence that was present. The right nostril was also made smaller.

On January 25, 1944 an operation was performed to make the left nostril smaller, and an elliptical piece of mucous membrane was removed from the median portion of the upper lip.

When the patient was seen on February 3, 1944 the outline of the lips and nostrils showed considerable improvement (fig. 19).

Case History No. 8—D. L. *This seventeen year old patient had been operated* upon by another surgeon in childhood. He had had a bilateral harelip and cleft palate.

Examination on December 11, 1945 revealed a large, badly deformed nose with prominent dorsal hump and a markedly retracted tip. The short columella added to the flattening of the lower part of the nose. The central part of the upper lip was very short and there were depressed scars on each side of it where it has been sutured to the lateral portions of the lip. Marked notching of the lip was present at the old suture lines. The lower lip was overdeveloped. The maxillary dental arch was retracted, the front teeth were distorted and

FIG. 29 a Pre-operative photograph of patient, Case IX, showing malignant lesion of the upper lip. 29 b Photograph (Case IX) following excision of lesion and transfer of a flap from the lower lip to the upper. 29 c Photograph (Case IX) two and a half years postoperatively.

decayed and there was a complete cleft of the palate (Fig. 20–21). There was a marked nasal tone to the speech.

On March 21, 1946 an operation was performed under intratracheal ether. The cleft in the palate was closed by local flaps and six teeth were removed from the anterior maxilla. In order to improve the alveolar ridge for the wearing of a denture, it was necessary to remove with a rongeur some of the bone in the region of the pre-maxillary process.

As soon as the palate had healed a denture was made by the patient's dentist under the direction of the writer.

On October 31, 1946 the next operation was performed using 2% novocaine and adrenalin for local infiltration and infraorbital nerve blocks. The old scar lines on the upper lip were excised, separating the central portion from the lateral parts of the upper lip. (fig. 22, 23). An incision was also made in the premaxillary portion of the upper lip separating its anterior and posterior halves. This incision was carried upward separating the cartilaginous from the membranous part of the septum so that the columella and the central portion of the upper lip could be advanced on the cartilaginous part of the septum to lengthen the columella. That portion of the premaxillary skin from the upper lip which had been advanced on the columella was split from below upward and anteriorly for approximately one-half inch and the lateral portions sutured to the lateral edges of the lower lip flap. A large flap approximately five-eights of an inch in width at its vermilion border end was taken from the lower lip and then turned up into the large defect of the upper lip (figs. 24, 25, 26, 27).

On November 13, 1946 a second stage Estlander-Abbe procedure was carried out under local anesthesia. In addition, an incision was made at the base of each nostril and around

the alae. A piece of tissue at the base of each nostril was excised and the nostrils were then sutured to the side of the columella thus narrowing the lower part of the nose.

When the patient was seen on March 5, 1947 the scars of the upper lip were hardly visible and he had started to grow a mustache. The vermilion border contour was good. There was still a moderate prominence of the dorsum of the nose with slight flatness of the tip, and the columella near the junction with the upper lip showed slight excess of tissue. This will require further operative treatment, fig. 28. There was considerable improvement in the speech of the patient.

Case History No. 9—N. B. This sixteen year old patient had been kicked on her upper lip by a horse in childhood, and had developed a wart like mass on her upper lip. She had been under the care of dermatologists for many years for this and for eczema. X-ray and diathermy treatments had been given without success. The lesion had not changed in size for approximately six months.

Physical examination on November 27, 1944 showed a crusted, ulcerated lesion approximately one half inch long and about one fifth of an inch in width. The borders were elevated and there was an area of induration surrounding them. There was no fixation (fig. 29 a).

The patient was seen again a month and a half later and the lesion found to be slightly larger.

On January 6, 1945 an operation was performed under intratracheal gas, oxygen ether anesthesia with the tube passed through the nose. In order to excise the lesion with an adequate margin it was necessary to remove almost half of the upper lip. A flap over one half inch wide was taken from the medial part of the lower lip and rotated into the defect in the upper lip (fig. 29 b).

The pathological report revealed Epidermoid carcinoma, Grade II with no evidence of tumor at the resected edges of the specimen.

On January 23, 1945 the patient was again operated upon. 2% novocaine and adrenalin were infiltrated locally and bilateral infraorbital and mental blocks were carried out. A second stage Estlander-Abbe procedure was performed at which time the flap was separated from its base on the lower lip.

The patient reported for a check up on January 10, 1947. There was no evidence of recurrence and the scar lines were hardly visible. The right upper lip was somewhat thin, and it was felt that it was probably due to atrophy from radiation therapy given in the past (Fig. 29 c).

THE SURGICAL TREATMENT OF PARALYTIC STENOSIS OF THE LARYNX

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Bilateral abductor paralysis of the larynx is a serious problem. These persons become dispneic, with breathlessness while talking; physical efforts are curtailed, breathing is noisy and there is a constant dread of asphyxiation. Emergency tracheotomy often must be resorted to. This is a terrifying experience and patients rarely relinquish their tubes which afford security against asphyxiation, in spite of the annoyance that they may cause.

Surgical attempts have been made to improve the laryngeal airway and many operations were devised. These consisted of removal of a portion of vocal cord, separation of the anterior extremities of the vocal cords or nerve anastomosis. Ventriculocordectomy, submucous resection of a cord, resection of the edge of a cord with the tip of the vocal process, lateral displacement of the anterior end of a cord and separation of the cords by thyrotomy represent some of the earlier procedures. These appeared to afford an adequate airway but the benefit was temporary and patients soon were confronted with recurrence of dyspnea due to cicatricial narrowing superimposed on the paralytic stenosis.

Nerve anastomosis appeared as a logical solution especially in the recent case. Difficulty, however, was encountered in finding the segments of the injured nerve and substitution of other nerve fibers was unsuccessful. I had the opportunity to observe a number of these but never saw a single satisfactory result.

In 1939, King (1) published his results following transposition of the omohyoid muscle to the arytenoid cartilage. This presented a new approach to this difficult problem and the early results gave promise. Certain modifications of the original technic were required because of muscle contractures in old cases of paralysis and the need to reinterpret the changes occurring in the larynx postoperatively (2).

In 1941, Kelly (3) reported results obtained by removal of an arytenoid cartilage through a resected window in the ala of the thyroid cartilage with fixation of the vocal cord to the external fascia. The functional results compared favorably with those obtained by the King technic.

McCall and Gardner (4) recommended transilluminating the larynx after exposure of the wing of the thyroid cartilage to aid in locating the position of the arytenoid and the site of the resected window. This was accomplished by direct laryngoscopy with an anterior commissure laryngoscope.

Orton (5) advocated removal of the posterior portion of the wing of the thyroid cartilage to facilitate the approach to the arytenoid cartilage.

Woodman (6) recommended partial arytenoidectomy with retention of the

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vocal process which he fastened to the inferior cornua of the thyroid cartilage with chromic catgut and this in turn was anchored to the sternomastoid muscle.

My first attempt at transposition of the omohyoid muscle to the arytenoid was made in 1940. It proved to be only partially successful. I attributed this lack of success to failure to shorten the omohyoid sufficiently. Later the procedure was repeated on the opposite side of the larynx and a successful result was secured.

In one of the early cases I could not identify the omohyoid muscle which had been previously incised while removing a large goitre. The arytenoid cartilage therefore was freely mobilized and secured with a chromic catgut suture to the posterior border of the wing of the thyroid cartilage. The result in this case was the best I had secured up to that time. Following that experience I no longer transposed the omohyoid muscle but mobilized the arytenoid and secured it laterally to the thyroid cartilage. Motion pictures of the larynx made before and after operation in several of the previous cases revealed conclusively that the arytenoid cartilage and vocal cord on the operated side remained immobile; the only movement noted on phonation was that of the unoperated arytenoid. This observation had been made by others and I believe it is now generally believed that the success of the operation is dependent on free mobilization of an arytenoid and its lateral fixation (7). Although I have not performed arytenoidectomy its advocates claim excellent results by removal of an arytenoid and lateral fixation of the vocal cord.

Technic of mobilization and lateral fixation of an arytenoid.—General anesthesia is commonly used although local anesthesia has been employed in several recent cases. I prefer ether anesthesia supplemented by avertin. If no tracheotomy has been performed one has the choice of inserting a Flagg airway preoperatively into the trachea and performing tracheotomy at the termination of the operation or the tracheotomy may be performed preoperatively and a small Flagg airway inserted through the tracheal stoma. One must be aware of the hazards of general anesthesia in a dyspneic patient. If preliminary tracheotomy has been performed a Flagg airway may be inserted through the tracheotomy stoma and secured. This keeps the anesthestist out of the way and diminishes the danger of wound contamination. Placement of a Flagg airway in the larynx facilitates localization of the arytenoid but I believe it increases the danger of injury to the mucosa when separating the capsule of the joint on its mesial aspect.

Incision. A two inch incision through the skin and platysma is made along the anterior border of the sternomastoid muscle, the upper and lower limits corresponding to the upper border of the thyroid cartilage and its inferior cornua. A better cosmetic result will be secured if a horizontal incision is made to conform to the creases of the neck. This should cross the posterior border of the thyroid cartilage slightly below its middle. The omohyoid may be retracted or incised. The posterior border of the thyroid cartilage is identified and the attachment of the inferior constrictor muscle is incised along its lower two-thirds. The examining finger may now identify the signet of the cricoid cartilage particularly its upper and lateral margins. The pharyngeal mucosa is separated from the cricoid carti-

lage towards the midline. The muscular process of the arytenoid is identified and the capsule of the cricoarytenoid joint may then be incised. It is desirable to separate the attachments of the posterior and lateral cricoarytenoid and the interarytenoid muscles, in addition to incising the capsule of the joint to assure adequate mobility of the arytenoid cartilage. Care should be exercised to avoid injury to the laryngeal and pharyngeal mucosa particularly when separating the mesial attachment of the capsule. I have found a small hook valuable to secure the arytenoid during the dissection.

Lateral fixation of the arytenoid is accomplished by securing it to the posterior border of the thyroid cartilage. Two chromic sutures previously employed have been replaced by one silk suture which is passed around the arytenoid cartilage rather than through it and secured through a hole made with a dental burr near the posterior border of the thyroid cartilage. This gives better fixation than if fascia or muscle is used. This suture places the vocal cord under tension and if mobilization has been adequate the vocal process should be tilted neither inward nor outward. Placing the opening for the suture at a point slightly higher than the original position of the arytenoid will increase the airway but also will increase impairment of the voice. The inferior constrictor is repaired and the wound closed preferably inserting a small rubber tissue drain for 48 hours.

In the earlier cases I routinely performed direct laryngoscopy before securing the arytenoid to determine if adequate separation was obtained. Too often it was difficult to evaluate the findings as the patient frequently was lightly anesthetized or edematous changes had occurred submucosally about the field of operation. I now secure the arytenoid so that it is in contact with the inner aspect of the thyroid cartilage without reference to the size of the glottis. With one exception in the last 26 cases the airway has been adequate. In the remaining case the airway proved to be too wide and the patient has only a whispered voice.

Variations in technic.—One of the problems in this procedure is to secure an adequate exposure of the arytenoid without resection of the posterior part of the thyroid cartilage. Retraction of the wing of the thyroid cartilage may be facilitated by separation of the articulation between the inferior cornua and the cricoid cartilage. It is possible that this may subsequently interfere with the mobility of the cricoid cartilage.

Occasionally it is difficult to place the suture in proper position about the arytenoid. As a rule this is best accomplished by passing the needle from behind forward. This suture should be placed beneath the mucosa. Perforation of the mucosa overlying the arytenoid may lead to the formation of a granuloma or to infection of the wound. If placement of the suture is difficult the mucosa overlying the posterior and inner aspect of the arytenoid should be separated. Occasionally a second suture has been placed about the arytenoid to aid in its lateral displacement.

Results.—One cannot hope to restore normal function in a case of bilateral abductor paralysis. Any attempt to improve the airway will detract from the patient's ability to phonate and the wider the glottis the poorer the voice. In

one case I secured unusual lateral displacement of the arytenoid with the result that the patient's voice is a loud whisper. While one may operate on both arytenoids it is far more desirable to do a unilateral operation only, for the *operated* arytenoid becomes the *fixed* arytenoid and such adduction as occurs during phonation is seen only on the unoperated side. This mobility can be explained by the action of the cricothyroid muscle, which, primarily a tensor, also exerts some adductor function. When the cricoid cartilage is drawn upward towards the thyroid cartilage by the cricothyroid muscle there is some tilting inward of the corresponding arytenoid which probably is a passive action, although the thyro-arytenoideus muscle by reason of its attachment to the vocal process also may act in a passive manner. In addition, I believe that many of these patients use the extrinsic laryngeal muscles and this may aid in narrowing the airway during phonation.

Patients who have either worn a tracheal cannula for relief of dyspnea or who have lived a precarious existence because of continued shortness of breath invariably are extremely grateful when the airway is increased so that they may breathe without difficulty. I have never observed a single instance in which the patient regretted having had the operation performed, this in spite of the fact that there has been definite impairment of the voice.

Statistical studies.—Thirty-two cases have been operated to date. In these 35 operations have been performed. The first two cases were not successful after the first operation and it was necessary to operate on the opposite side. Case #18 also required an operation on the opposite side because of recurrence of dyspnea. This was due to marked edema of the arytenoid on the operated side. There had been no wound infection but the assumption was that there was some chondritis of the arytenoid cartilage. Following operation on the opposite side the patient developed an excellent airway and the voice is remarkably good considering that both arytenoids now are immobile. In case #3, no benefit was derived from transposition of the omohyoid. The patient, a teacher, wears a valved tracheal cannula, has an excellent voice and for the present has decided to have no further surgical interference.

Sex.—Of the group 26 were females and 6 males. The ages of 31 varied from 25 to 64 years with one patient 14 years of age.

Etiology.—In 29 instances the bilateral paralysis followed thyroidectomy. In several of these there was a unilateral paralysis following the first operation and the opposite cord was paralyzed at a secondary operation. In three instances the bilateral paralysis followed an infection possibly of viral origin. The appearance of the larynx was identical with that occurring after thyroidectomy. In two of these the paralysis was of two years duration and in one, a boy aged 14 years, the duration was over 7 years. The duration of the paralysis in the post-thyroidectomy group was one to 10 years in 19 cases, and 10 to 24½ years in 12 cases, 3 being more than 20 years. With separation of the interarytenoid, posterior and lateral cricoarytenoid muscles and incision of the capsule no apparent differences could be detected in the end results of either the recent or long duration cases.

Decannulation was carried out on the 9th day postoperatively in the earliest case and in the longest the tube was removed after three months. This patient developed a small granuloma in the posterior commissure apparently springing from the operated side. There probably was some injury to the mucosa by the suture which resulted in this complication. Removal of the granuloma was followed by complete recovery and decannulation with a reasonably good voice. A majority of the patients were decannulated within one month after operation.

Infection of the wound due to injury to the laryngeal mucosa occurred in 4 cases. Convalescence was delayed but a satisfactory result was secured in each instance.

Voice changes.—In one patient the voice is only a loud whisper. In this, the arytenoid was moved too far laterally. Of the remaining patients none have normal voices but all have reasonably good husky voices and, strangely, all are pleased with the results. In the one unsuccessful case operation was recommended on the opposite side but the patient is pleased with the result secured by tracheotomy which was performed preliminary to the first operation.

In conclusion, I consider mobilization and lateral fixation of an arytenoid an excellent procedure for improving the airway in bilateral paralytic stenosis of the larynx. I have not performed arytenoidectomy therefore can give no opinion concerning that procedure. In 32 operated cases 4 cases were unsuccessful after the first operation, but in 3 of these a satisfactory result was secured following operation on the opposite side. The remaining case refused a second operation. In every successfully operated case there has been impairment of the voice but this has been overshadowed by the improvement of the airway.

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COMPRESSIVE SUSPENSION SPLINT FOR SEVERELY COMMINUTED FRACTURES

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The fundamental principles in the treatment of nasal fractures are based on the realignment of the displaced fragments and their consolidation by proper immobilization. The reduction of a comminuted fracture is relatively simple at an early stage; it is more laborious after consolidation has taken place. For this reason, to assure patency of the nasal passages as well as to prevent establishment of the deformity, early resetting is a major goal.

The alignment and immobilization of early fractures do not require elaborate instrumentation in the majority of cases. External and endonasal splinting is an important factor in their accomplishment (fig. 1).

The modern rhinoplastic approach should rely on the reduction and immobilization of the fracture without the application of excessive force by bulky and traumatizing instruments.

In *simple* fractures which are not badly comminuted and in which the support of the frontal processes is available or can be reconstituted, distal fixation is unnecessary to immobilize the reset fragments. Their elevation and support can best be provided by an endonasal packing with iodoform or vaseline gauze inserted high under the dorsum: this should be introduced under direct vision without obstructing the nasal passages in which rubber breathing tubes are inserted (fig. 1).

In severely depressed and comminuted fractures endonasal support alone is insufficient to maintain proper alignment (fig. 2). Here the septum and the frontal processes are badly damaged and displaced and distal fixation is required to maintain the elevation of the reset parts. The use of endonasal packing is also contraindicated here because of the possibility of intracranial involvement. As the severely comminuted fracture is usually the product of violent crushing trauma, the possibility of injury to the ethmoid bone and the prevention of meningeal complications, becomes the primary consideration. When such a clinical picture presents itself, the resetting of the fracture should be postponed for about two weeks in order to avoid disruption of the fragments, with possible damage to the meninges.

Many appliances with distal fixation for endonasal support have been suggested for the reduction and immobilization of severely comminuted fractures. All of them are complicated in construction and laborious to apply. As a result, occasional attempts to use them are liable to failure. Most of them are based on the principle of a forehand band with two separate attachments used *alternately:* one, carrying adjustable endonasal rods, serves to elevate the depressed bridge; the other, carrying two lateral plates, provides for narrowing of the dorsum (1).

An appliance of this type, to be adequate, must combine the forward traction of the depressed fragments together with their medial mobilization to counteract the widening of the bridge. If narrowing is deferred for several weeks after reduction, as recommended in connection with most of these appliances, inward mobilization of the fragments by external pressure is doubtful if not impossible, at such an advanced phase of consolidation.

An additional inconvenience in the use of these appliances is the plaster of paris cast in which the forehand band is incorporated.

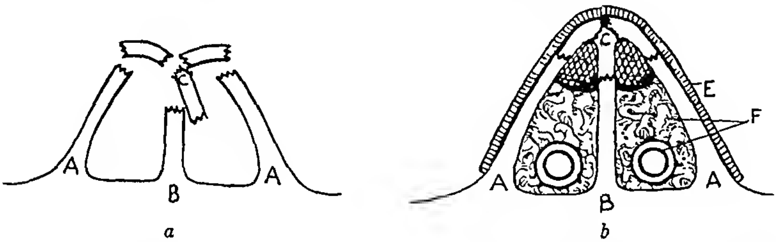

FIG. 1*a:* Comminuted depressed fracture without impaction and with restorable septum. This type can often be repaired by endonasal manipulation and packing. *b:* Displaced fragments of septum (B) are restored to position and affixed with a mattress suture. Upper fragments (C) are supported by packing around tube placed along nasal floor (F). Lead splint (E) provides external fixation. A.—Frontal processes. C.—Dorsal fragments.

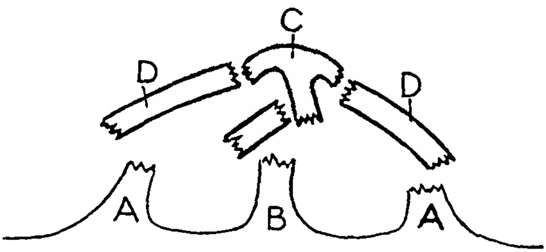

FIG. 2: Severely comminuted depressed fracture with involvement of lateral processes (A) and septum. (B) Resetting and immobilization of fragments (C, D) requires distal fixation.

The author's combined suspension and narrowing splint with distal fixation on the maxillae, fulfills the requirements for adequate early reduction of a severely comminuted fracture* (fig. 3).

APPLICATION OF SPLINT

Preliminary Preparations: Following thorough cleansing of nasal cavities and removal of clots and free bony fragments, the lacerated mucous membrane flaps and supporting parts are carefully reassembled. The reset septum is held together by a few mattress sutures. When, as often happens, the lower border of the septum is dislocated along the floor of the nose, a fracture forceps may be

* V. Mueller and Co., Chicago and Pilling Co., Philadelphia.

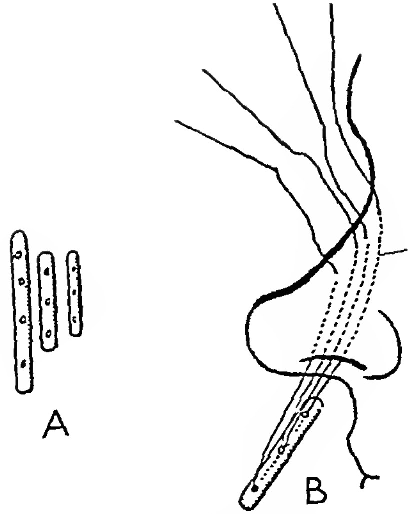

FIG. 3: Insertion of acrylic splints for early elevation of depressed bridge. A.—Perforated acrylic splints of three sizes, from 1″ to 1½″. B.—Splints are inserted beneath dorsum by means of wires (b) threaded on straight needles.

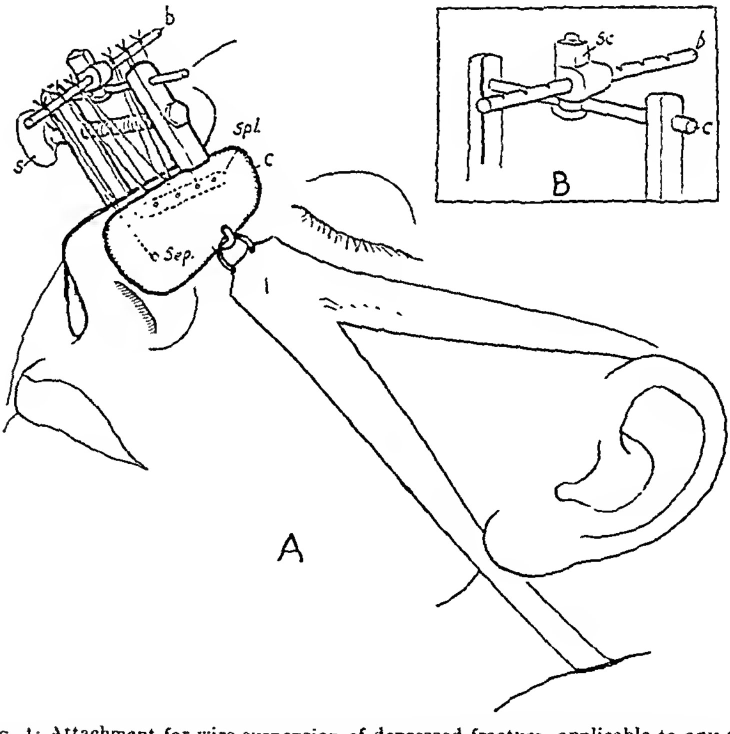

FIG. 4. Attachment for wire-suspension of depressed fracture, applicable to any compressor. A.—Wire-suspension of acrylic splints (spl) and septum (sep) from grooved bar (b) of author's device. s.—Screw of compressor (c). B.—Details of suspension device attachable to any compressor. Notched rod (b) in holder, fixed in position by screw (sc). Rod and holder slide on bar (c). Entire apparatus held in place by ribbon.

used to centralize it. The fragmented nasal bones and frontal processes are raised by means of a blunt septal elevator covered by thin rubber tubing.

The elevation and maintenance of the crushed dorsum is now carried out by the application of endonasal and external splints. The required instrumentation consists of a compressor with a suspension rod, two acrylic splints, straight needles and stainless wire (figs. 3 and 4).

Perforated acrylic splints of appropriate size are inserted high along the dorsum on each side by means of wires threaded on straight needles (fig. 3). An additional wire passes through the upper septal fragment and through the dorsum on each side. All wires are attached to a notched rod secured by a

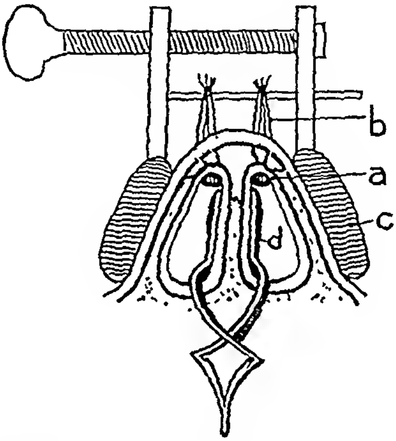

FIG. 5 Acrylic splints (a) beneath depressed dorsum, suspended by wires (b) from horizontal bar of bilateral compressor (c). d—Verdier's septal splint holding muco-periosteal flaps together

holder to the horizontal bar of a bilateral compressor (fig. 4). This rod is movable in horizontal and sagittal planes, thereby permitting proper adjustment of the wires. The latter can also be attached directly to the horizontal bar of a nasal compressor; this however does not allow for an even distribution of traction along a line parallel to the depressed dorsum (fig. 5).

Prior to suspension of wires from the notched rod (b) of compressor (c), the position of the acrylic splints and bony fragments is checked by external palpation. The tightening of the lateral rods of the compressor plates keeps the dorsum from spreading, thus minimizing swelling.

The chief advantage of this method is simplicity of instrumentation and technique. Narrowing and elevation of the dorsum are achieved simultaneously at the optimum time thus assuring better cosmetic result. The caved septum is elevated by the same procedure. Nasal passages remain free during treatment, as no packing is required.

SUMMARY

A simple instrumentation for early reduction of badly comminuted depressed fractures is presented.

It consists of a compressor with suspension rod, two acrylic splints, a few straight needles and stainless wire.

The chief advantages of this procedure are:

Simplicity of application and elimination of cumbersome appliances and plaster-of-paris headgear.

Narrowing and elevation of the depressed bridge are accomplished simultaneously at the earliest time, thereby assuring a satisfactory cosmetic result.

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THE USE OF OPEN JUMP FLAPS IN LOWER EXTREMITY REPAIRS*

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The development of a simple direct method for resurfacing the large, broad surface defects and extensive deep scars of the lower extremities has reduced the time needed to complete a repair from many months to several weeks. The use of the open jump flap from the abdominal wall instead of a long tubed flap permits the covering of wider defects with better skin, and the earlier undertaking of deep surgical repairs. Results by this method are so satisfactory that jump flaps have sometimes been preferred to large local flaps because the procedure is more rapid, less hazardous, and no additional scarring is produced on the already damaged leg.

The success of any deep surgery depends on the surface healing. Bone grafts, screws, plates, wire, etc. have been removed from wounds that broke open because the skin closure over them was unsatisfactory. Only with healthy skin covering, often secured through the medium of a flap, can healing be assured. It is interesting that following the removal of all deep scar over an unhealed ununited fracture and immediate repair by a flap, spontaneous bony union of the fracture has occurred. Flaps are also important to replace scar epithelium in areas exposed to bumps and blows even if deep surgery is not contemplated. This simple direct method is valuable for those rare but extensive scars.

A short broad pedicle maintained throughout all stages of the transfer is fundamental in the use of the open jump flap from the abdominal wall. Suffi-

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This work has been done in association with Lt. Col. David Fisher, Major Pierson Cherket, Capt. Milton Edgerton and Capt. James E. Jensen.

cient mobility of the arm and leg to be brought into apposition is essential, but it has been possible to use this flap successfully to the leg at the level of a stiff knee or for total covering of the foot. Selection of which arm is to carry the flap and to which side of the arm the flap is attached must be determined individually. To achieve the transfer with the least discomfort in the cramped position is the goal. Allowance of an excess of at least one third in the size of the flap is necessary to compensate for shrinkage. Insufficient excess may necessitate a second flap to complete the repair.

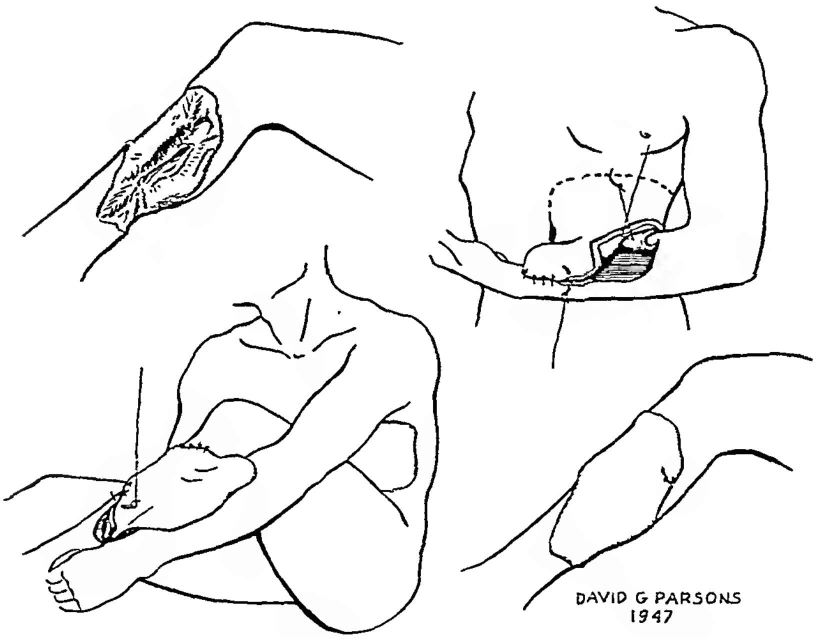

FIG. 1. Illustrating the steps in the preparation and transfer of an open jump flap to lower leg.

TECHNIQUE

Narrow flaps with a broad base of corresponding size are elevated on the forearm and at a suitable place on the abdominal or chest walls. The width of the base of the flaps is determined by the size of the defect in the leg. They are sutured together with complete overlap of the abdominal flap on the forearm. Any uncovered area on the abdominal wall is grafted.

The preparation of the "pancake" on the abdominal or chest walls usually requires several delays and is started after about two weeks. The delays are carried out by partially incising the margin of the flap and undermining a part of it. The interruption of the vessels entering the flap is the purpose of this procedure, which is usually completed in two or three stages at weekly intervals.

FIG. 2. Resurfacing of bony cavity below knee with open jump flap. No additional bony support needed after surface repair. Completed with six operations in fourteen weeks.

FIG 3 Resurfacing of mid-portion of lower leg with open jump flap preliminary to bone graft for non-union of tibia. Previously had pedicle flap from opposite leg followed by an unsuccessful bone graft More adequate surface covering secured by large open flap at this time. Completed with five operations in eleven weeks

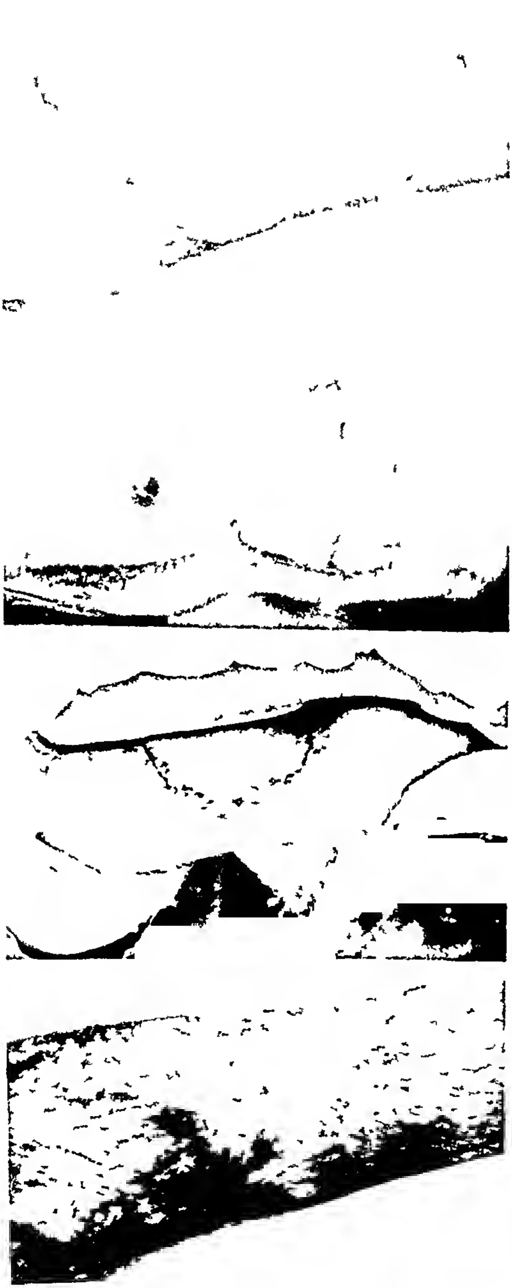

FIG 4 Replacement of scar below knee with open jump flap prior to successful on lay bone graft Completed with five operations in eleven weeks

All incisions are closed at each stage and pressure dressings applied using cotton mechanics waste and adhesive fixation for the flap and the arm.

The next step is the transfer of the flap to the leg. After detaching the flap the area from which it was taken is closed with a thick split graft. All superficial and deep scar of the leg or foot is removed until a freely bleeding surface is reached. The operating table is adjusted so that the patient is supported with the arm and leg in apposition. Additional support by sandbags or pillows may be helpful. The flap is then fitted to the defect and sutured accurately in place with buried and skin stitches. Only that part of the scar is removed which can be covered by the flap at this stage. The remainder is removed after the flap is cut free and ready for final adjustment. Fixation and support are usually best secured with a plaster cast, but adhesive strapping may prove adequate. The flap must be delayed in separating it from the arm. Usually two or three stages are sufficient. The adjustment of the flap and the closure of the forearm can be done when the pedicle is cut free or postponed until later.

Anesthesia for the transfer of the flap to the leg may be with local infiltration of both areas or local infiltration of the chest and abdominal walls and a low spinal for the leg. The latter method simplifies the securing of a skin graft to close the chest or abdominal walls. It has been found that more adequate and more comfortable fixation is possible with cooperation from the patient.

COMMENT

Many patient hospital-days have been saved by the development of more direct methods in reparative surgery. The open jump flap from the abdominal wall for large lower extremity defects is an example of such a development. By this method the procedure from the first operation to the final adjustment can be completed in as short a time as 10–12 weeks. The average time is between 12 and 16 weeks. The practically unlimited width and length of these flaps makes them ideal for resurfacing extensive areas of the leg and there is minimal hazard in the transfer because a broad attachment is maintained at all times.

Sensation returns slowly in flaps and may never return if the regional nerve supply is destroyed. Consequently, daily careful examination of the anesthetic skin must be made by the patient to avoid necrosis and ulceration from weight bearing, burns or other trauma.

SUMMARY

The use of the open jump flap in lower extremity repairs is described.

The more rapid completion of large repairs by this flap than by other types of flaps is emphasized.

The importance of a short broad attachment to the forearm throughout the procedure is indicated.

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SUCCESSFUL HOMOLOGOUS SKIN GRAFTING IN A WAR BURN USING AN IDENTICAL TWIN AS DONOR

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AND

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Under the present status of our knowledge, it is impossible to assure homologous skin transplantation between individual human beings of ordinary genetic diversity (1). An initial take occurs with skin homografts removed from any donor and these homografts have approximately the same gross behavior as autografts during a period varying from two to eight weeks. However, as early as four or five days after transplantation, most homografts are histologically distinguishable from autografts because they provoke a local inflammatory reaction in which plasma cells and lymphocytes are the dominant cell types. The destruction of the homografts which appear to "melt" away, is also preceded by a vascular breakdown. Recent experimental work has further showed that a condition of immunity is developed in the animal who has received a homograft (2). When a second homologous skin graft is applied there occurs an inhibitory reaction which shows a high degree of specificity toward the skin of the animal that provided the earlier immunizing dose of homograft.

Grafting of homologous skin has been successfully done from one identical twin to another. Previous reports (3, 4, 5, 6) on the success of skin grafting between identical twins are confirmed by the following case history. Its unusual feature is that a homograft was performed upon a patient who had suffered extensive skin loss following a war burn.

HISTORY

A 19 year old French soldier was admitted to the National Reconstructive Surgery Center on July 1st, 1945. The patient had been burned by a phosphorous grenade during the fighting in Austria on May 3, 1945. He presented an area of full thickness skin loss resulting from deep burns of the left lower extremity, extending over the posterior, lateral and medial aspects of the thigh and down to the junction of the upper with the middle third of the leg. Another area of skin loss, about 10 x 15 cm. in size was situated lower down on the posterior aspect of the leg (fig. 1). About one half of the right thigh presented healing dermal burns with a small area (5 x 4 cm.) of full thickness loss on the medial aspect. The granulating areas were grossly suppurating and found infected by hemolytic streptococcus and bacillus pyocyaneus.

The preoperative treatment consisted in careful cleansing and pressure dressings. The patient was given a protein high diet and two days before operation a blood transfusion of 1000 cc. of blood was administered and penicillin (100,000 units daily) was started.

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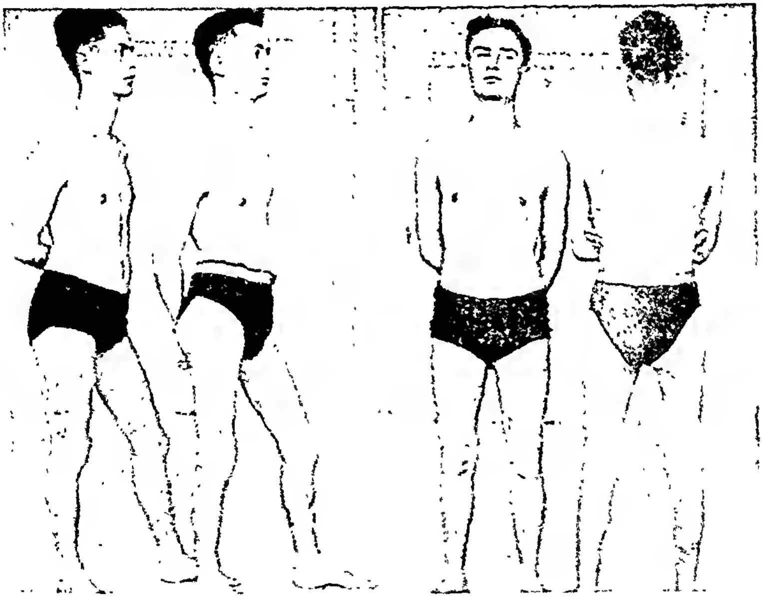
FIG. 1. Granulating Area of the Lower Extremity Following a Burn by a Phosphorous Hand Grenade. Aspect of the Wound on July 10, 1945.



A B

FIG. 2. October 20, 1945

A (left) Patient's twin. Donor areas of homogenous skin grafts may be seen on his thighs. (right) The patient has achieved a successful functional recovery following autogenous and homogenous skin grafting.

B (left) Patient's twin. (right) Right lower extremity has been successfully covered by autogenous skin grafts in the upper half of the burn wound and by homogenous skin grafts in the lower half. Donor areas of autogenous skin grafts are seen on patient's back.

Operation: Autografting. On July 17, 1945 five drums of skin (6 x 4 inches each) were removed with the dermatome (16/1000 inch thickness) from the patient's back. These grafts were sutured in place after the excision of the superficial layer of the granulating

tissue of the upper part of the left thigh. A pressure dressing was applied. This first operation resulted in a 100% "take" of the autografts. A few days after this operation, the "patient" was seen walking around the hospital in apparently perfect health. It was then discovered that the "patient" was in reality the twin brother of the burned patient. After confirmation that the twins were monozygotic or identical twins, it was decided that, rather than subject the patient to the discomfort of the removal of skin grafts from his chest and abdomen, the required skin grafts would be taken from his brother.

Operation: Homografting. On September 3, 1945 the equivalent of five drums (6 x 4 inches each) of skin grafts (16/1000 inch in thickness) were removed from the brother's thighs and abdomen. After the resection of the superficial layer of granulations on the patient's left lower extremity, these homografts were sutured in place and held by pressure dressings. During the operation, the patient received 300 cc. of plasma and 700 cc. of blood. Penicillin therapy (100,000 units daily) was started.

Fate of the Homografts. Seven days after the skin homografting operation, the pressure dressings were removed and the grafting was found to be successful. The subsequent behaviour of the homografts did not differ in any way from that of the autografts. The patient achieved complete functional recovery (fig. 2). Recent correspondence (1947) with the patient has confirmed the complete persistence and functional stability of the homografts.

SUMMARY

A case of successful grafting of homologous skin taken from the patient's identical twin is reported. The homografts were used to complete the covering of an area of full thickness skin loss following a war burn. The behaviour of the homografts did not differ in any way from that of previously applied autografts.

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A METHOD FOR RESTORATION OF THE CILIA OF THE EYELIDS

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The usual method for restoration of cilia was to take a free hair bearing graft horizontal to and including a portion of the lower part of the eyebrow. The disadvantage of this type of graft was that the hairs were not spaced as in the eyelashes nor is their direction similar. Many normal persons do not have the upward growth of cilia at the nasal end, all cilia maintaining a temporal direction throughout the entire length of the brow (fig. 1). In other cases the inner end

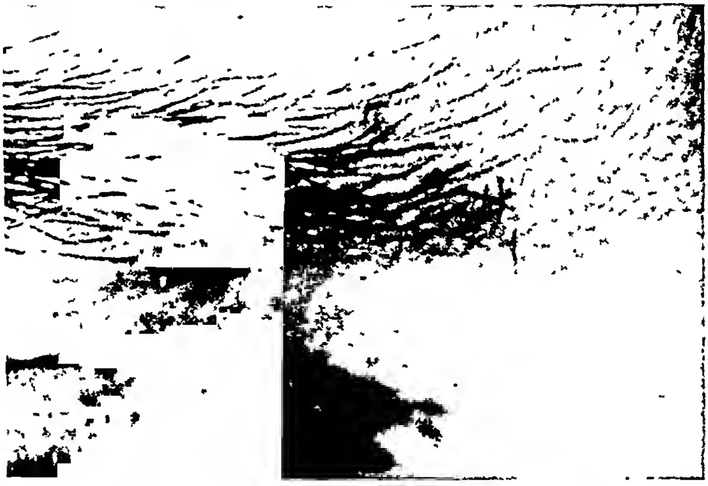

FIG. 1 ILLUSTRATING INDIVIDUAL WITH ONLY TEMPORAL DIRECTION OF GROWTH OF CILIA IN EYEBROW

of the brow may be involved in scarring from healed wounds or perhaps may have been used for previous lash transplants.

We have used a free hair bearing graft taken vertical to the eyebrow and have been very pleased with the results. The hairs are spaced more similar and the direction the same as the normal eyelashes. If the defect is larger than the width of the eyebrow then two free hair bearing grafts can be taken.

TECHNIQUE

A free hair bearing graft is taken about three millimeters wide by making two paralled incisions vertically through the eyebrow. This is wide enough to include three or four rows of cilia and is deep enough to include a thin layer of subcutaneous fat. Frequently all the cilia in the graft fall out following the surgical

procedure and commonly the marginal rows do not regenerate. The more central row or rows, however, begin to grow out again after a month or so. The section is lifted from the eyebrow by small hooks and placed in the new bed which has been formed in the lid margin. Care should be taken to see that the graft is so placed that the hair on the graft is in the same direction as the normal eyelashes. The graft is then sutured with fine silk sutures leaving every other suture long to be used later to tie the dressing down with pressure. This dressing is left in place for one week and then removed.

Fig. 2 Original Condition of Lower Lid—Laceration with Cicatricial Ectropion
Repaired by realigning lower lid margin, and filling in lower lid with full-thickness skin graft from behind ear.

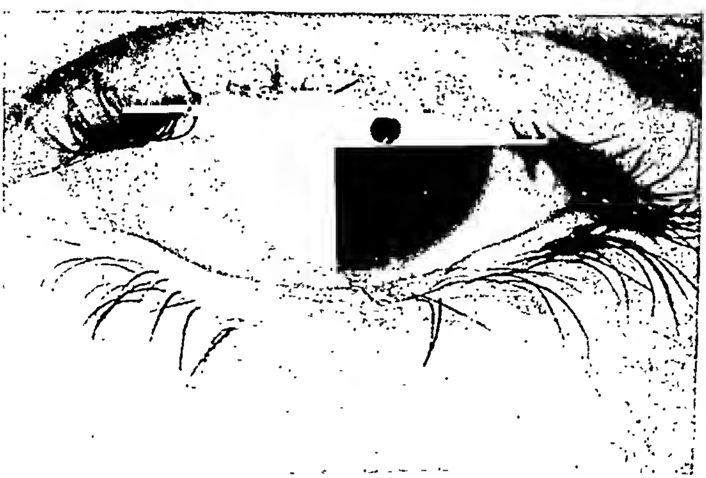

Fig. 3 Case Showing Loss of Eyelashes from Center of Upper and Lower Lids

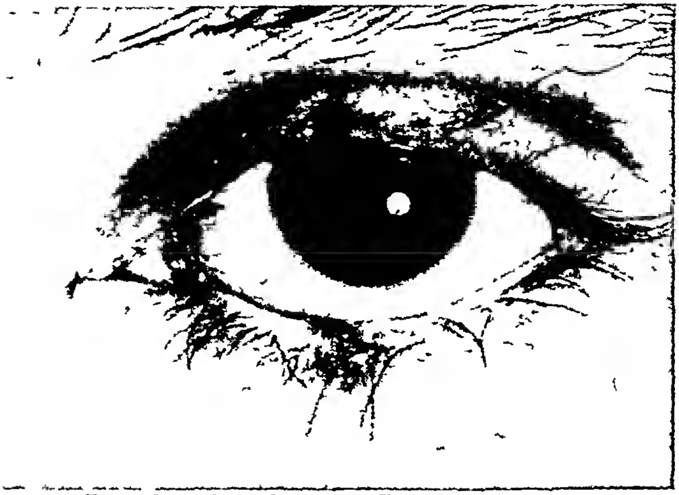

FIG 4 SAME CASE FOLLOWING EYELASH TRANSPLANT

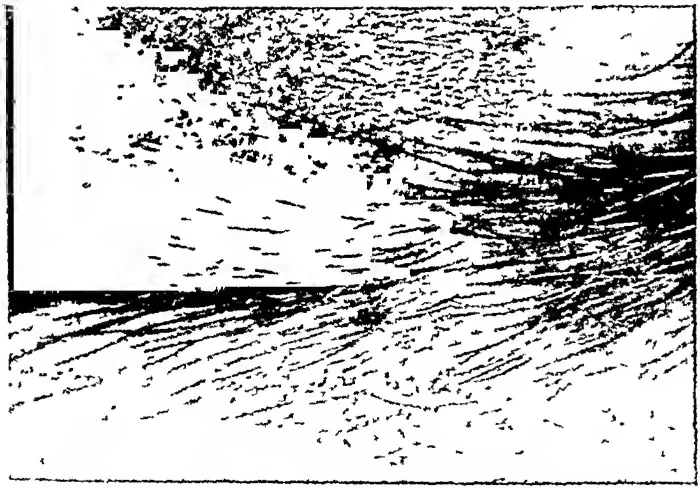

FIG 5 SHOWING SCAR IN EYEBROW FOLLOWING GRAFT REMOVAL

THE BLOOD CIRCULATION IN PEDICLE FLAPS

Preliminary Studies on a Photo-Electric Test For Determining Its Efficiency

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In a previous article (1) which bore the same main title one of us with Dr. R. R. Buchholz reported the use of a "temperature-return test" employing a sensitive thermocouple apparatus by which the viability of tube flaps could be determined before transfer of a pedicle. In both dogs and humans this test affords a means of saving time between stages.

The present test, employing an apparatus developed during the war for measuring continuously the oxygen saturation of arterial blood in man (2), represents an improvement in that room temperature need not be controlled, readings may be made directly instead of being calculated from a formula and tests require approximately one-twelfth of the time consumed by the previous method.

The adequacy of circulation in the flaps is estimated from the speed with which blood enters the flap following the release of a tourniquet. Blood content of the flap is measured photoelectrically by a simple modification of an oximeter ear unit. Since the present method measures only changes in the total amount of blood in the flap, it cannot distinguish unequivocally between the efficiency of arterial supply and of venous drainage but only in the balance between them. The rapid return of blood to a previously "milked" flap after releasing the tourniquet tells us that the supply of blood to the flap is good, but tells us nothing about the adequacy with which blood is carried away. Decreased blood content following the release of a tourniquet indicates efficiency of venous drainage. In the present preliminary studies we have concentrated our attention on the arterial supply side of a picture, though incidental observations have suggested that the method may also be applied to study of the venous return as well.

The oximeter ear unit consists of a U-shaped structure bearing a small incandescent lamp on one leg, and a photocell assembly on the other, which contains two barrier-type photocells, each covered with color filter, one red and one green. In its usual form, the oximeter unit is designed to be slipped over the ear, being held in place by an adjustable knurled ring which surrounds the lamp.

For the present experiments, such a unit has been modified in the following ways (see fig. 1): (a) The photocell housing has been reduced to a little over 2 mm. in thickness, being little thicker than the barrier cell itself. This enables the photocell to slip under even a short flap with little stretching or distortion, and hence with a minimum effect on the circulation. (b) An adjustment has been added to the lamp support, so that it can be fitted to flaps of different thickness,

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and to allow the lamp to be put in place after pressing blood out of the flap and applying a tourniquet to each end.

Upon releasing the tourniquet around one end of the previously "milked" flap, while the other is left on, blood enters the flap at a rate corresponding to the distribution and pattern of the patient's communicating blood vessels. The resultant flushing greatly reduces the transmission of light through it, and this change can be followed continuously by means of the lamp on one side of the flap and the photocell on the other side. Ideally, green light should be used for this measurement, because the photocell current then depends *only* upon total blood content of the flap and is independent of the color of the contained blood. The absorption of red light depends both on the amount of the pigment and on its concentration. However, under the conditions of the present experiments, it

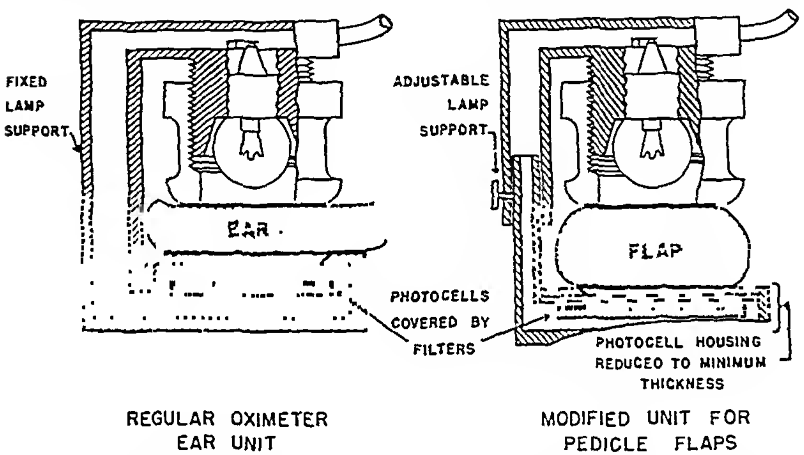

FIG 1. Cross section diagram of oximeter ear unit and modified unit for pedicle flaps

was unnecessary thus to limit ourselves, as the overwhelmingly predominant optical effect on releasing the tourniquet was change in total blood content. Thus, in practice either the "red" or the "green" photocell could be used, and the red was usually employed because of its much larger output and greater convenience of measurement. It is possible by the use of two or more photocells to follow simultaneously and independently both the changes in total blood content in the flap, and changes in the color of this blood (which is related to the oxygen pressure in it) as is routinely done with the oximeter in its usual application on the ear. Thus both circulatory and metabolic activity in the flap can be studied at the same time. Preliminary experiments with flaps which have not been "milked" of their blood, but whose circulation has been arrested by tourniquets, have shown easily measureable changes caused by the reduction of the oxyhemoglobin, as the oxygen stores in the tissue become exhausted. We hope to report on this aspect of the work at a later time, the present paper is limited to comparatively sudden changes in circulation.

The method should not be limited to light-skinned individuals, since it is only *changes* in pigment concentration or hue which are observed. *Proportional* changes in light transmission due to circulation and metabolism will be just the same in a tissue with little or with much skin pigmentation. A quantity of fixed pigment in the skin would, however, reduce the base line, and require either more light or a higher sensitivity setting for the photoelectric device, but would not otherwise affect the results. With the present experimental arrangement, a considerable amount of pigment would cause no trouble. For very dark skins, it would probably be necessary to modify the galvanometer, the photocell, or the light source. We are well below the maximum possible limits in all but the third item.

DESCRIPTION OF TYPICAL TEST

APPARATUS. In addition to the oximeter one usually needs only two ordinary inch and a half screw-clamps with rubber covered jaws or two specially designed miniature pneumatic tourniquets resembling ordinary sphygmomanometer cuffs described in a previous article (1). The latter are preferable because they produce a negligible degree of trauma even when applied at frequent intervals. The blood circulation is cut off by tightening the tourniquet around the flap at one end; the flap is then pressed free of blood by digital pressure or by the pneumatic girdle described below. Without allowing a return of circulation the other tourniquet is now tightened. The oximeter unit is adjusted on the flap, and the lamp brightness adjusted to give a convenient galvanometer reading. As soon as the photocurrent has become stabilized at a constant level for from 20 seconds to two minutes, the pressure of the tourniquet at one end is quickly removed and readings are taken at further five second intervals for a period of two to three minutes. The entrance of blood into the tissue is now indicated by the change in galvanometer reading. When after a minute or two the current reaches a relatively stable low value, indicating a maximum collection of blood in the flap, the other tourniquet is removed. Usually, there is a moderate rise in the photocurrent when this second tourniquet is released due to the outward drainage of blood in the flap from this end. The test is then repeated, but the tourniquets are released in the reverse order. In this way the efficiency of the circulation through each pedicle may be tested without damage to the flap even though the latter has recently been formed surgically, and stitches are still present in it. The method has been shown to be adequate in testing flaps as wide as $2\frac{1}{2}$ inches, in other words, in testing a tube or rope approximately one inch in diameter.

OXIMETER TEST READINGS ON PEDICLE FLAPS

The tests already performed have given such clear cut results that we feel they are of definite predictive value.

Figure 2 shows the effect of releasing first the nasal tourniquet on a pedicle flap and then the lateral or temporal tourniquet, both tourniquets having been applied after "milking" the blood from the flap. This test performed on the patient shown in figure 3 indicated a good circulation in the flap.

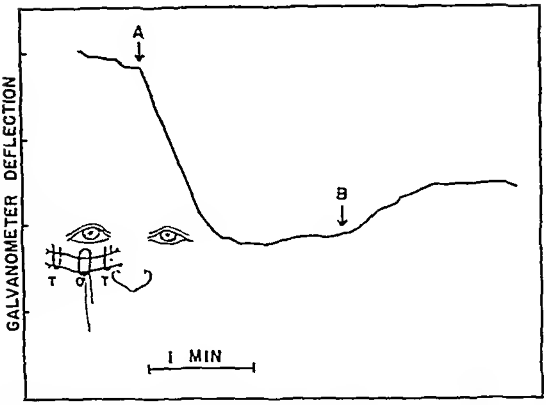

FIG. 2. Oximeter test of circulation of pedicle flap on patient A W. Flap extending from nose to temporal region. A—tourniquet off nasal end B—tourniquet off temporal end.

FIG. 3. Complete oximeter test applied. Left to right: galvanometer, control unit, wire leads, tourniquet, and lighted oximeter unit Left inset below close up of oximeter unit. Top inset. enlarged view of flap Right inset below: enlarged view with oximeter light on during test.

Following this evidence, the medial end of the flap was successfully shifted in position to form a new eyelid. The rise in the curve occurring upon release of the lateral tourniquet is interpreted to mean that blood is draining from the lateral end and freely circulating through the flap after both tourniquets are off.

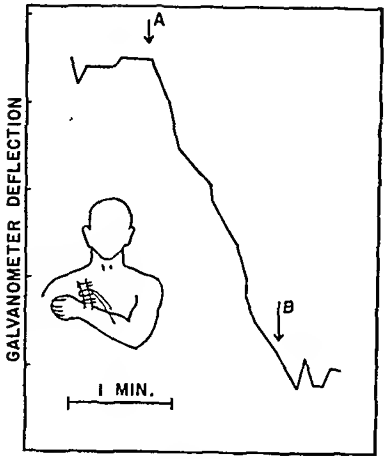

Fig. 4

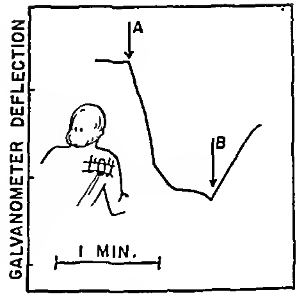

Fig. 5

Fig. 4. Oximeter test showing excellent circulatory response in pedicle flap of patient G. A. Tourniquet A—off wrist end 14 days post operative. B—tourniquet off original end on right shoulder.

Fig. 5. Oximeter test readings Patient D. P. A—Tourniquet off lateral end (6 day) B—tourniquet off medial end (original).

Fig. 6. Patient D. P. with oximeter applied on flap from medial to lateral side of shoulder.

Figure 4 is the record obtained on a shoulder-wrist flap of a young adult. The figure shows the circulation through the end of the flap opposite to the one it was proposed to shift. The quick and abundant return of blood to the flap when the

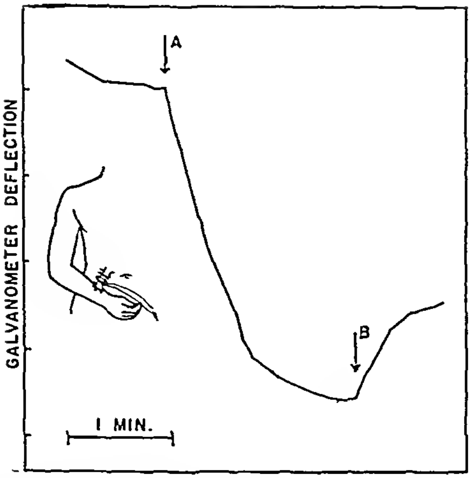

FIG. 7. Oximeter test of circulation through pedicle flap. Patient J. P., boy, age 13. Flap formed on abdomen then one end shifted to wrist. A—tourniquet off wrist end (formed 7 days). B—tourniquet off abdominal end (original). Circulation adequate through end A.

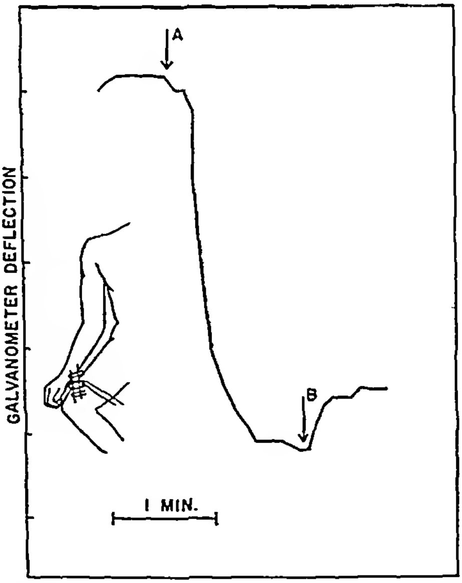

FIG. 8. Oximeter test of circulation. Patient J. P., age 13. Pedicle flap both ends of which had been shifted from original positions. A—tourniquet off knee (13 day end). B—tourniquet wrist end (24 days).

tourniquet was released from the wrist end of the flap showed that it was ready to shift to the opposite shoulder. It is to be noted that although the tube flap was very large ($\frac{3}{4}$ inch in diameter, $2\frac{1}{4}$ inches in width before tubing) the oximeter unit could easily be adjusted upon it. A four inch flap could just as easily be tested, since any tube flap may easily be flattened sufficiently to be inserted between the light and the sensitive cell without causing enough pressure to interfere with the free circulation of blood.

Figure 5 shows a lesser though adequate response in a girl nineteen years of age in which a flap had been raised in the scapular region extending from the skin

FIG. 9. Oximeter unit in place on forearm—knee pedicle flap on 13 year old boy. For test results see figure 8. Inset: Oximeter on lateral to medial knee flaps.

near the mid line obliquely downward for a distance of six inches. The test was made only six days after the first operation. The flap end was shifted successfully three days later. See figure 6 taken during test.

Figure 7 reveals the state of the circulation passing through each end of a pedicle rope flap extending from the abdomen to the wrist.

Figure 8 shows the same when the abdominal end of the flap had been transferred to its permanent recipient site on the right knee. Photographs in figure 9.

EXPERIMENTAL FLAPS

In order to study the development of circulation in more detail we used a dog. Under nembutal anaesthesia with aseptic technique two parallel incisions were made $1\frac{1}{2}$ inches apart from the chest region $1\frac{1}{2}$ inches inferior to the right axilla vertically downward for a distance of 6 inches to a point on the abdomen about

the same distance above the fold under the right thigh. Skin and subcutaneous tissue were undermined and a pedicle flap was formed. The skin was then closed under the flap (see fig. 10).

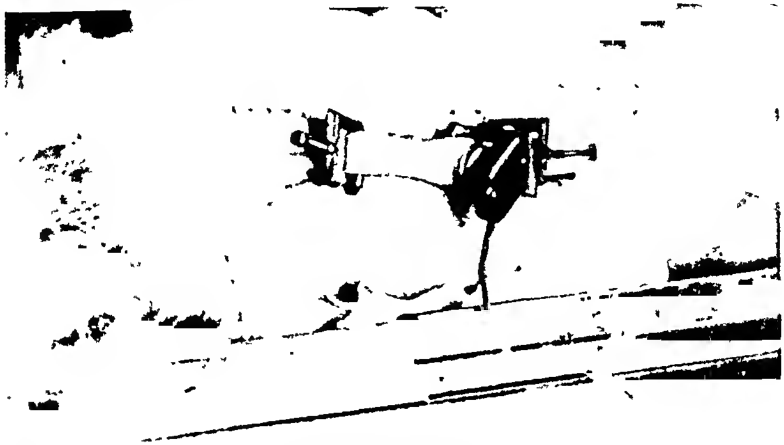

FIG. 10. Application of tourniquets and oximeter unit to pedicle flap on abdomen of dog. Note sutures not yet removed from upper end of flap.

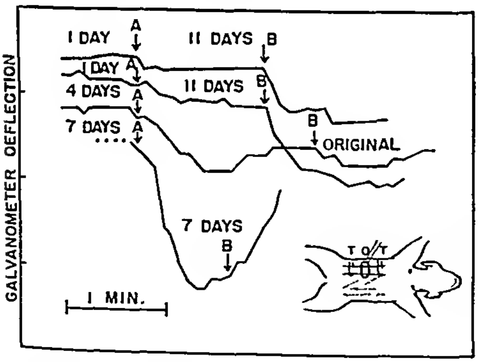

FIG. 11

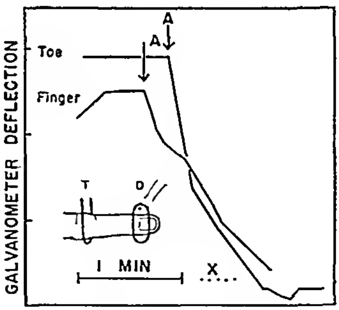

FIG. 12

FIG. 11. Oximeter tests on pedicle flap on dog 126, shifted to new positions as shown in dotted lines in inset. A—tourniquet off 1 end. B—off other in all cases Second line from top shows top record repeated as a test of accuracy of results. Note progressive increase of circulatory efficiency with increasing age of flaps.

FIG. 12. Tests on finger and toe. Subject B D After blood of digit is emptied from vessels by even digital compression a rubber band tourniquet was applied around digit at web level. Sharp deflection downward on release of tourniquet, indicates excellent return of circulation.

The progressive development of a more adequate circulation through this flap at various ageing intervals is shown in Fig. 11. Later the lower end of the flap was shifted and still later the upper. After each shift as the vessels in the flap became dilated in a more nearly straight line with respect to the length of the

flap and the circulation therefore became more adequate, the oximeter response became more regular and quantitatively greater.

Finally, when both pedicles of the flap had been shifted from their original positions so that the entire flap was forced to depend upon new vascular connections, the circulatory efficiency was retested and, as would have been expected, the response was very weak through the end which had been connected only 24 hours before but quite strong through the other end. The test was repeated in order to check its accuracy and the same results were obtained. These are the two upper records of figure 11.

CIRCULATION TESTS ON NORMAL FINGERS AND TOES

Figure 12 shows similar records obtained on fingers and toes, which may be compared to blind-ended pedicle flaps. The records were obtained by pressing

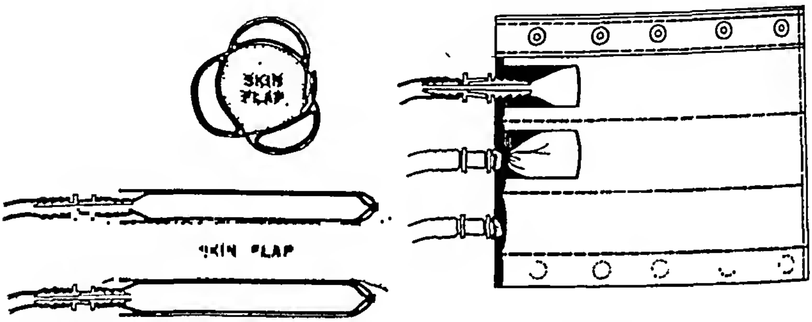

FIG. 13. Pneumatic—girdle compression tourniquet for emptying blood from tube or rope flaps. Left upper: Cross section. Left lower: Longitudinal section showing rubber compression chambers (inflated) with oiled silk covering Right. Semi-diagramatic drawing showing "snaps" for fastening girdle around flap.

the blood out of the fingers and toes of Dr. Douglas, and applying a small rubber Penrose drain tourniquet tightly about the bases of the digits, the light being adjusted to illuminate the finger through the nail bed and register on the photocell beneath. Results follow closely those obtained with pedicle flaps.

NEW APPARATUS

Further improvements are now being made in the form and mounting of the tourniquets used, and in the manner of supporting and adjusting the photocell unit. These should enable the method to be adapted more conveniently and more reliably to a wide assortment of flap sizes and shapes, although not essential to the performance of an adequate test. Figure 13 shows a new pneumatic sleeve tourniquet which has proved valuable in expressing the blood from the flap, by applying instant and even pressure.

SUMMARY

An oximeter test for circulatory adequacy in tissues such as pedicle flaps and extremities has been developed. Studies of several flaps on humans, in various

locations and on a dog are presented in detail. The circulation of human fingers and toes has also been tested. Some of the flaps successfully tested have been quite large—over 2¼ inches in width before tubing.

CONCLUSIONS

1. The oximeter test offers a very rapid method of testing the circulatory efficiency of pedicle flaps.

2. Predictions of successful transfer based on the test have been justified in all eight cases in which it has been applied, indicating a high degree of reliability.

3. It is an improvement on the "Temperature Return Test" developed by Douglas and Buchholz, since it is more rapidly accomplished, and appears to be equally reliable.

4. Rapid increases in the blood content of pedicle flaps following the release of tourniquets have been recorded with the oximeter.

5. Since it appears that flaps may safely be transferred as soon as the oximeter test gives evidence of adequate circulation, considerable saving of time between operations may be effected by the use of the test.

6. Preliminary experiments indicate that the photoelectric method can also be applied to the study of metabolic processes as well as circulatory changes in pedicle flaps and in small extremities.

7. Tests on the circulation of normal fingers and toes indicate a wider surgical and medical use for the technique.

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USEFUL PROCEDURES IN PLASTIC SURGERY*

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AND V. L. BERGERON, M.D.

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All of us who do plastic surgery have worked out, over the years, numerous useful procedures and details of technique. Success in our work is due not to one or two large factors but to an infinite number of small details, to great patience and to constant care. As we visit our confreres we see their special maneuvers, discuss these and often adopt them. Following are some useful procedures which we use:

For preoperative skin preparation careful cleansing with a bland soap and sterile cotton, as advocated by Koch and Mason, has given gratifying results, definitely decreasing the incidence of infection over methods using chemicals which apparently lower resistance of the normal cells to infection.

There is one gross defect in the technique of the modern American operating room which is so glaring that one wonders how it can persist in the otherwise near perfect surgical set-up. All of you have seen the following picture not once, but many times, in many surgeries. In the longer operations, those accompanied by some loss of blood, for example a breast operation, the blood will run down onto the drapes which cover the sides of the table. Instruments and sponges are dropped or laid on this shelf. Long before, sterility has been lost through capillarity by contamination from the unsterile table pad beneath the drapes. The instruments parked there, and the sponges, find their way into the wound, and the instruments are laid often in the same place. Perhaps a half hour later, with the area so bloodied that it irks even the surgeon, he will call for a towel. This is opened by the nurse and the surgeon picks up the instruments and sponges, spreads one thickness of towel over the bloodied area and replaces the instruments and sponges. In one or two minutes the fresh towel is soaked through and the previous condition recurs. If infection occurs in the wound postoperatively and is reported to the head operating room nurse, there is great scurrying about, culture of sutures, gloves, packs, dressings, and this and that, while the most probable source of infection is blithely disregarded. When this danger is called to the attention of the head nurses, and the surgeons, it is often dismissed with the shrug of a shoulder. The cure is simple. Every sterile drape we use in the region of an operative field is backed by sterile patapar paper. That is an impervious heavy paper easily autoclaved and usable many times. Perhaps some of the new sheet plastics would be even better.

This patapar paper is used to back the drapes for our instrument tables where the tray cannot be taken out and sterilized. So often solutions or water are spilled on the back tables and would otherwise cause instant contamination.

* Read before the annual meeting of Plastic and Reconstructive Surgery at Kansas City, Missouri, November 15, 1946.

To prevent novocaine solutions being spilled, we use a tray holding two medicine glasses. The tray is formed of two parallel sheets of metal separated by four shouldered rods which fit through appropriately drilled holes at the corners. On each threaded end of the rods is placed a round nut. The upper plate has two holes cut a little larger than the medicine glasses. Metal caps can be had for these medicine glasses and these we use, keeping the novocaine solutions free from contamination, from the room dust, or from anything which might be dropped into them while being passed over the instrument table. Any solution which is to be injected should and must be guarded carefully. Novocaine solutions must be poured in our presence, checked before and after pouring, and the scrub nurse is not even allowed to hold the glass, so she does not assume any responsibility. I learned the hard way many years ago. A nurse gave me alcohol instead of novocaine and the mistake cost the hospital $40,000, and the nurse her career.

To handle tissue, especially flaps and skin edges, we use hooks of various sizes, some specially made, down to the finest eye hooks, believing them a great asset to atraumatic surgery. We never pick up skin edges with thumb forceps.

I want to mention one special suture that we believe excellent, and to explain the reason for its use. That is the drawn nylon suture, size 5-0 or 4-0, which comes in a tube and with the cutting edge needle swedged on. Contrary to the original claims of the manufacturer it is not moisture proof, but its value is greatly enhanced by soaking in water for fifteen or twenty minutes before using, thus decreasing its brittleness. If then picked up by both ends and stretched, its special value can be demonstrated as it possesses a splendid elasticity. The only other elastic suture we possess is horsehair and that is weak, brittle and larger at one end than at the other. Edema follows every operation and this faculty of elasticity enables the suture to accommodate itself to the edema. The water soaking prevents the suture breaking at the knot.

A handy maneuver for subcuticular sutures has proven useful in their removal. Originally subcuticular sutures were tied at each end and one end had to be untied for removal. For many years I have used a slip knot at the first end of the suture through which is passed a piece of heavy silkworm-gut, one-quarter of an inch long. The knot is pulled taut over the silkworm bar, the subcuticular stitch completed and the other end tied. For removal the tied knot is cut and the suture pulled out easily by grasping the silkworm-gut bar.

All patients dread insertion of hypodermic needles, especially the initial injection in local anaesthesia. We have been helped greatly in this difficulty by the use of 30 gauge stainless steel needles. Pain is much less complained of. With their use we commonly operate on children seven to ten years of age, under local anaesthesia. It is necessary, of course, for the surgeon to sell himself to the child—without the well-meaning help of the mother. We promise the child to stop if there is any pain, and we keep the promise.

To tie bleeders on a bed prepared to receive a free skin graft, we use Luken's 0 or 00, a raw silk. It does not work through the graft. To sterilize any silk thread, we would call your attention to the fact that silk shrinks when boiled,

and if wound tightly many of the fibres will be broken, greatly weakening the thread. We wind them on soft rubber tubes, and wind them over a hemostat which is withdrawn after the winding is completed.

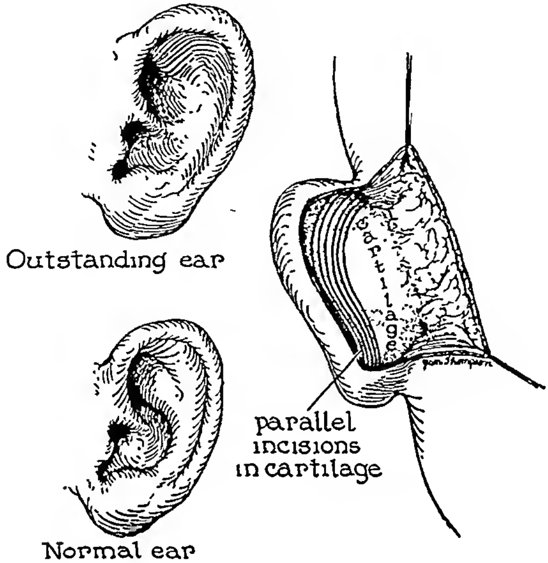

FIG. 1

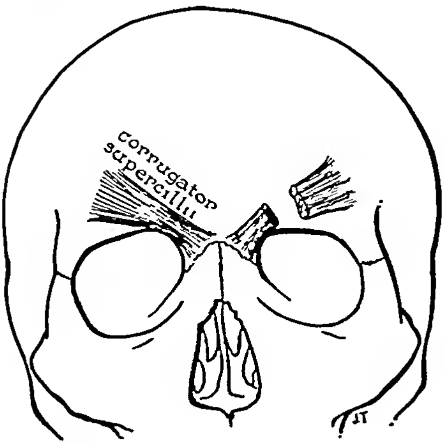

FIG. 2

Our early attempts to set back outstanding ears were not satisfactory. We followed the usual method of removing an ellipse of skin and cartilage from behind the ear. This results in a sharp ridge at the front of the ear opposite the cartilage removal, an abnormal contour. A study of outstanding ears will reveal

that they do not assume this position because of too much cartilage, but because the pinna lacks the normal antihelix fold just anterior to the helix.

Our first efforts to reproduce this fold were failures, a thinning of the cartilage from behind, but the thinning produced only another ridge. Then came cross hatching, better but still not satisfactory. Finally the use of eight or ten parallel incisions almost through the cartilage in the line of the desired fold gave quite an accurate representation of the normal fold. Figure 1.

4-0 plain catgut sutures were used to tack the ear back and hold the fold. Excess skin was removed and the skin sutured with running Dermalon 5-0. Vaseline gauze was packed into the concha and a light pressure applied with bias bandage over a cotton pad.

Another maneuver which has proven useful is the correction of an habitual frown by surgery. Deep frown lines are often due to eyestrain. Many people try to emphasize their statements by violent frowning—a bad habit. A school teacher came to us recently for help. She had very deep frown lines and said that the children feared her because of them.

To correct this deformity the cause should be studied. Frowning is accomplished by the action of the corrugator supercilii muscles, one on each side arising from a narrow tendinous origin on each side of the cephalic ends of the nasal bones, and then spreading lateralward in fan shape between the two layers of the orbicularis palpebrarum and underneath the frontalis to be inserted into the under surface of the skin of the forehead.

Our procedure is to incise through the medial end of each eyebrow, expose the corrugator supercilii and excise a good portion of the body of the muscle. (Figure 2). Simple incision through the muscle is not enough as the healed ends will join together with scar and will again function. The muscle is supplied by the seventh cranial nerve which comes in from the lateral side. The corrugators should be identified carefully, and the supraorbital vessels and nerve retracted before the muscle fibres are cut. After excising the muscle, the skin of the forehead in the glabellar region should be completely undermined, and after suture of the incisions, gentle pressure should be applied with the dressing.

A PLASTIC OPERATIVE PROCEDURE FOR THE REPAIR OF LARGE CIRCULAR OR ELLIPTICAL BODY SURFACE DEFECTS

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Large circular or elliptical body surface defects are chiefly formed after the removal of malignant tumors, excision of old atonic wound surfaces, and function-hindering scars. In cases of malignant tumors originating from the skin and the soft parts (usually sarcomas and carcinomas) there always exists the justified tendency to operate far into the sound tissue, since only in this way can a recurrence be avoided and a permanent cure be obtained. Naturally, there result only too often as a consequence of such tumor operations large losses of substance embracing the deep fasciae and muscular layers, which mean for the patients a long subsequent treatment and further plastic operations. The same is true in the removal of function-hindering scarred and ulcerated portions of the skin and of the soft parts, respectively. In the interest of the subsequent plastic closure of the operation-wound, one is compelled here, too, to reach as closely as possible the tissue border which is sound and rich with blood vessels, so that extensive body surface defects appear likewise after such operative interventions. It should further be mentioned that after certain injuries on the surface of the body there occurs here and there an extensive circular loss of substance which may require a normal skin covering.

In cases of fresh extensive circular or elliptical operative wounds, usually at the completion of the operation, the procedure is to undertake at once a corresponding reduction of the defect by mobilization of the wound edges, leaving the remaining part of the wound to a secondary plastic closure. In cases of older body surface defects we proceed differently from case to case. In the majority of instances—where the defective part of the body is not exposed to any considerable injurious influences, has no special functional requirements to meet, and, most important, affords good wound conditions—we have recourse to the easily-performed epidermis transplant (as done by Thiersch and Reverdin). In other cases, however, owing to the scarred, poorly vascularized bottom of the wound, or to special functional requirements, or to the danger of a new cicatrization and contracture, we are forced to effect the closure with normal skin, although this treatment means complicated distant skin grafting, lengthy treatment, and much discomfort and pain to the patient.

Whether we have to deal with a fresh loss of substance, such as after the removal of a tumor, or with trauma, or with an old scarred tissue defect, there arises in any case the temptation to have the plastic closure of the wound done at one sitting, through skin flap shifting from the closest vicinity, as this operative procedure is more natural, quicker, and less painful.

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Below is described an operative procedure which makes it possible to close quite large circular or elliptical body surface defects by utilizing the neighboring skin cover. The main idea here is to obtain as much covering material as possible by means of a fair distribution of the repair task on all the skin surrounding the wound.

Taking into consideration the local vessel supply, there are made immediately at the circular or at the long side of the elliptical defect, respectively, two skin flaps, a quadrangular (EABCD = a) and a triangular (TAB = b), figure 1. For this purpose two skin incisions are required, an oblique one (AB) and another one (BC) which runs more or less parallel to the defect's edge and which can moreover be continued far enough in the direction towards D. Both skin incisions have their common starting point (B) at the tangent (FTB). The oblique incision (AB) amounts, with the circular-shaped defect, to about its radius length; with the elliptical-shaped defect it is correspondingly longer. Thus the skin flaps are, with the circular defect, somewhat wider and shorter; with the elliptical one, correspondingly narrower and longer. It is important that the lengthening incision (CD) should be so drawn as to assure width of the pedicle of the flap (a), (figure 1, the spot marked with crosses). It should be mentioned that the width of the flap (a) amounts to about one-half to two-thirds of the width of the defect. The quadrangular skin flap is then raised, while at the same time the flap is mobilized of its pedicle (figure 1, the spot marked with crosses) and pulled over the defect (figure 2, a). Then the triangular skin flap is sufficiently mobilized (figure 2, the spot marked with circles) and shifted downward to the left in such a way that it may fill the lower uncovered area of the defect and also as much as possible of the operation wound newly formed through the shifting of the flap (a), (figure 3). After this step there still remain three uncovered areas which are closed without any difficulty through mobilization of the adjacent skin edges. The suture lines (figure 4) formed after the operation show in a clear manner (note, for instance, the tangent FTB left aside) the equal participation of the whole defects surroundings in the closure of the circular body surface defect.

The operative procedure described enables the repair of quite large circular or elliptical defects. Up to the present it has been successfully applied to three different regions of the body.

In the first instance it was a large ulcerated carcinoma that occupied the whole front upper region of the shoulder. After a radical operation, in the course of which it also became necessary to remove the fascia and the superficial layer of the deltoid muscle, there appeared a circular loss of substance 9 x 10 centimeters large. The latter was closed at the same sitting in the above-described manner. In a few days the patient was perfectly healthy, with a sound shoulder joint. Figures 5 to 8 show the patient in question before and after the operation, as well as a short time later when leaving the Clinic.

The second patient came to us with a sarcoma which originated from the soft parts and occupied a considerable part of the right upper back region. After the surgical removal there resulted a large elliptical-shaped wound of about 11

centimeters, which was at once closed in the described manner. Figures 9 to 11 show the patient before the operation, immediately after it, and 14 days later.

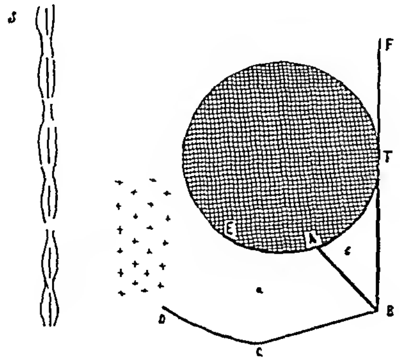

FIG. 1

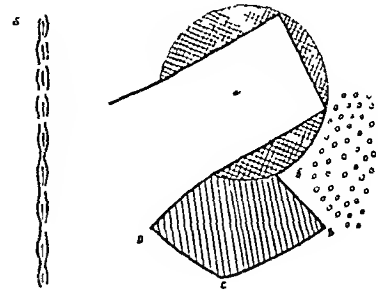

FIG. 2

FIG. 1. Square-covered circle, circular-shaped defect; AB, oblique skin incision; BC, skin incision running about parallel to the wound edge; CD, continued incision; EABCD = a, quadrangular skin flap; TAB = b, triangular skin flap; FTB, tangent; spot marked with crosses, pedicle of flap (a) which is *to be mobilized*; S, spinal column.

FIG. 2. Flap (a) is pulled over the defect. Spot marked with circles, pedicle of triangular skin flap which is to be *mobilized*.

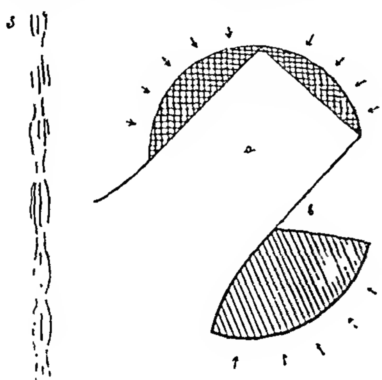

FIG. 3

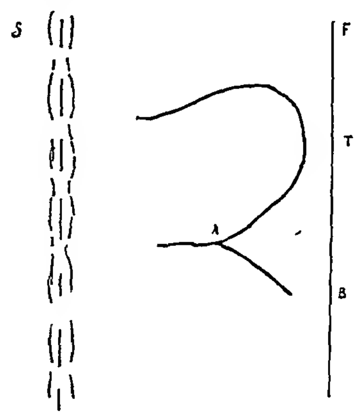

FIG. 4

FIG. 3. Flap (a) is pulled over the defect. Skin flap (b) is drawn downward to the left by means of which the operation wound newly formed through the shifting of flap (a) is covered. The three uncovered areas are closed by means of a corresponding mobilization of the skin edges.

FIG. 4. The suture lines formed after the operation. FTB, former position of the tangent.

The third patient had a large exulcerated scarring of the right ischial and trochanter region, caused three years previously by a bomb injury. At the same time the trochanter major had also been carried away, together with the soft

Fig 5

Fig 6

Fig 7

Fig 8

Figs 5 to 8 Case 1 before and after the operation, as well as a short time later when leaving the Clinic

parts, so that the ulcers were situated directly on the bone In the meantime there had been made, in the Clinic, several medical and surgical attempts to

heal the ulcers. After excision of the scar-ulcerated soft part portion reaching the bone, there appeared a 12 x 13 centimeter large oval operation wound which was closed at the same sitting. Figures 12 to 14 show the operation wound, its filling by means of two skin flaps taken from the abdominal inguinal region, and the complete cure.

Fig. 9

Fig. 10

Fig. 11

Figs. 9 to 11. Case 2 before the operation, immediately after it, and 14 days later.

Fig. 12

Fig. 13

Fig. 14

Figs. 12 to 14. Defect formed after excision of the scar-ulcerated soft part portion, its plastic closure, and the cured state.

SUMMARY

An operative procedure for the repair of large circular or elliptical body surface defects is described which enables the obtainment of as much covering material as possible through a fair distribution of the repair task on all the skin surrounding the wound. Of the two skin flaps raised on the defect side the quadrangular one (a) is pulled over the defect, whereas the triangular one (b) is drawn down to the left in such a manner as to close the lower uncovered defect region and as

much as possible of the operation wound newly formed by the shifting of the quadrangular flap (a). The three areas still left uncovered are closed without difficulty through the mobilization of the corresponding skin edges.

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REPORT OF CLINICS HELD BY EARL C. PADGETT, M.D. AND STAFF

AT THE

ANNUAL MEETING OF THE AMERICAN SOCIETY OF PLASTIC AND RECONSTRUCTIVE SURGERY

AT THE

UNIVERSITY OF KANSAS HOSPITALS, NOVEMBER 14 AND 15, 1946.

SKIN GRAFTING OF THE BURNED PATIENT. *Presented by* Kathryn Lyle Stephenson, M.D.

HARELIP AND CLEFT PALATE REPAIR. *Presented by* Earl C. Padgett, M.D. *Reported by* Kathryn Lyle Stephenson, M.D.

SURFACE LOSSES OF PENIS, SCROTUM AND URETHRA. *Presented by* David W. Robinson, M.D.

DEFORMITIES AND ABNORMALITIES OF THE JAW. *Presented by* David W. Robinson, M.D.

SKIN FLAPS. *Presented by* Earl C. Padgett, M.D. *Reported by* David W. Robinson, M.D.

> Dr. Padgett's death on December 2, 1946 occurred before he had completed the reports of the clinics which he and his staff presented. These reports have been very kindly prepared by Kathryn Lyle Stephenson, M.D. and David W. Robinson, M.D., Assistants to Earl C. Padgett, M.D.

SKIN GRAFTING OF THE BURNED PATIENT

During the past three years we have had occasion to see a great number of patients with serious burns and we believe that our results have improved due to three factors primarily:

(1) Proper early care when the patient fell into our hands promptly following the burn.

(2) Proper intermediate care previous to skin grafting, especially having regard for the importance of the systemic state of the patient.

(3) Early skin grafting in amounts sufficient to cover the denuded area in one operation if possible.

We will summarize briefly the early care of the patient mainly to emphasize that proper early care of the patient in shock lessens the problems of the phase of toxemia and to stress that we initiate at the outset a plan of procedure which will result in early skin coverage.

Our routine has no particularly distinctive features except, perhaps, the recognition of the importance of the time element in the care of the burned patient. As soon as the patient has been adequately examined and a concept of the individual's general condition and severity of injury obtained, we have instituted treatment for the prevention or correction of shock. Blood is withdrawn for haemoglobin, white count, typing and crossmatch, and plasma proteins, the needle left in the vein to receive the infusion of plasma which is to be continued with whole blood. Small amounts of morphine and barbituate are given and intranasal gastric tubes established for the purpose of administering fluids.

Under relatively aseptic conditions the burned areas are gently cleansed with white soap and water and ointment pressure dressings are applied. No matter how extensive the burn this procedure has never been permitted to take more than an hour and sufficient personnel employed so that the patient has not been kept in the operating or emergency room for a longer period. Local care aims at converting the contaminated wound into a clean wound with the preservation of as much epidermal covering as remains and the application of bandages that control oozing. All of these efforts on our part are for the purpose of limiting the development of infection, large plasma loss, anemia, and nutritional failure.

During the preoperative period the problem is fundamentally the maintenance of good nutrition in the presence of excessive nitrogen demands with perhaps the further problem of renal and hepatic dysfunction. As soon as the patient is brought to the surgical floor the program has been outlined. Orally or through the indwelling tubes fluids have been forced so that the adult patient has a fluid output of at least 1500 cc. daily. The diet has been calculated on the basis of 4 grams of protein per kilogram of body weight per 24 hours and it has been closely checked and supplemented with amino acid concentrates as needed. The maintenance of the tissue proteins of the body we think has decreased the transfusion requirements. The haemoglobin has been closely checked and transfusions of whole blood given daily if needed. Penicillin, 10,000 units every three hours, has been routine. Total and fractionated proteins have been checked with the knowledge that they are the last indicator of tissue protein depletion. Weight of the patient has been noted.

On about the tenth to fourteenth day we have changed the dressings to wet dressings using boric acid, saline, penicillin solution, or 2% acetic acid as indicated by the wound culture. Immediately preoperatively, we have changed the dressings twice daily. In old burns it has been necessary to do extensive debridement along with the wet dressing. The excessive boggy granulation tissue has been controlled by the application of tight dressings. Frequently, contractures are present which necessitate relief. We have preferred to use splints and gradual traction by the use of Stienmen pins, weights, etc., preoperatively to forcible stretching at the time of surgery. These patients suffering from burns of long standing are considerably more difficult problems systemically and often require as long a period of preparation for surgery as the burn which has been under our care from the onset.

Our primary criteria as to when the area is "ready to go" has been the presence

of proliferating filmy white margins of epithelium and a cherry red granulation bed. We have usually had our patients ready for surgery within three weeks after reception of the burn. To extend the preoperative period is to permit further weight loss, tissue protein loss, blood loss and depletion of the patient with an increase in complications due to malnutrition, secondary anemia, and secondary infection.

At the time of surgery the operative group is split into two teams. One team removes the skin and promptly transfers it to the other team who sutures it in place. The patient is usually kept under anaesthetic for an hour, at the most an hour and a half. Pressure dressings are applied to the granulating areas and zeroform dressings to contractural areas that have been grafted. Zeroform dressings which are not changed for ten days are applied to the donor area.

Postoperatively the patient is regarded with extreme care the first four days and daily transfusions may again be necessary to compensate for the blood and plasma loss occasioned by further skin loss at surgery. Patients may be ready for discharge on the third post-operative week unless secondary infection prevents complete epithelization. We have thought that complete coverage of the granulating surface in one operative procedure is fundamental.

The following cases were presented to illustrate our handling of some of these problems:

W. P. A sixteen year old boy who had suffered from burns of the legs 1½ years prior to our care and has had a previous skin grafting operation which had resulted in large unhealed areas because of improper taking of the graft with the dermatome. He had been subjected to a second skin grafting operation but the skin had not taken due to secondary infection and his poor nutritional state. He had been given thyroid, insulin, pituitary extracts and ultraviolet treatments. He became our problem with a total protein of 4.8 mgm. per cent, orthostatic calculi and gross malnutrition. We instituted our regime of high protein feedings which we checked, gave him whole blood transfusions, and testosterone proprionate and careful dressing care. He was discharged four months later after a total period of hospitalization of 22 months.

D. L. A three year old white male was burned on the right side of his body from his thigh to his neck, three months prior to admission into the hospital. At the time of admission he weighed 26 pounds, had a large decubitus on his occiput and was suffering from ascariasis. He was skin grafted with four drums of skin taken from his left hip, left thigh, left thorax and right thigh. He was discharged one year later with complete healing and weighing forty pounds. (Figure 1A & B.)

E. S. White male age 6, was burned 7 weeks prior to admission and had suffered considerable weight loss and anorexia. He had involvement of all of one leg and the back of the thigh and part of the other leg. Forced feeding was the main problem. He was cleaned up in one week, had seven incomplete drums of skin taken from his abdomen, chest, back, and thigh. He had a complete take and was discharged 3 weeks later.

L. L. Colored girl, age 6, was admitted to the emergency room with a 24 per cent body burn and was treated for shock and then our routine pressure dressings applied. Within 24 hours she had 2, 500 cc. of plasma. She necessitated only 1000 cc. of blood during her hospital course. She was grafted on the 36th day with four complete drums of skin and she was discharged on the 50th day with complete healing but there is some axillary contracture to be relieved. Constant self-contamination made it difficult to obtain a satisfactorily clean granulating area. She consumed an average of 92 of the 125 grams of daily dietary protein provided.

A

B

FIG. 1A & B. D. L. AGE 3½. SIX WEEKS FOLLOWING BURN
D. L. AGE 4. ONE YEAR LATER

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A

B

FIG. 3A & B. C. M. SIX MONTHS FOLLOWING BURN OF LEGS. LEGS THREE WEEKS LATER FOLLOWING GRAFT OF TEN INCOMPLETE DRUMS OF SKIN

discharged 150 days following admission and received a total of 12,000 cc. of whole blood while here

M. C Patient seen in 1933 at which time he suffered contractions of the neck, axilla, and thigh with loss of ear due to burns received in 1931 He had full thickness graft to his

W. C. An ex-army pilot burned both legs completely with gasoline. He was admitted to St. Luke's hospital for initial care on 2/20/46 and was taken to surgery 3/10/46 at which time 11 drums of skin were taken from his chest, abdomen, and thighs and applied to his legs. He was at all times in a good nutritional state due to his forced aminoid feedings and he was discharged 4/28/46. He only required 1500 cc. of whole blood and 1000 cc. of plasma during his hospital stay. (Figure 2)

A. S. W. M. age 26 adm. 11/19/45 because of burns of legs and axilla unhealed 8 months following reception of injury. He had five drums of skin applied six days after admission and was discharged 25 days later. He is at present having an ear constructed.

W. B. Age 21 was burned on his left arm, thorax, leg and thigh three weeks prior to admission. On entrance to our hospital he was dehydrated, febrile, and had a haemoglobin of 68 per cent and a white count of 17,350. His total protein was 5.94, alb. 2.53. He was placed on a 3,000 cal., 300 grams of protein daily diet. He received 5 transfusions of 500 cc. of whole blood. He had 8 drums of skin used for coverage with a good take but because of infection of the donor area with haemolytic staphylococcic aureus his discharge from the hospital was delayed and he had a total hospitalization of 65 days.

FIG. 2. W. C. APPEARANCE OF LEGS THREE WEEKS FOLLOWING SKIN GRAFT USING ELEVEN DRUMS OF SKIN

C. M. A 16 year old boy who six months previously had suffered burns of both legs while putting gas in a tractor. Two days prior to admission he developed nausea, hematuria, hematomas and became jaundiced and dehydrated. On admission he weighed forty pounds less than his usual weight, had an interic index of 50, Hb. of 68 per cent, W. B. C. of 19,000 and his total protein was 4.82 and Alb. 2 5. His wound culture showed Haemolytic staphylococci aureus and Haemolytic streptococci. One week following his admission he was taken to surgery and ten partial drums of skin were taken. He received 3,000 cc. of blood and was discharged one month later with complete healing. (Figure 3A & B)

J. G. A 17 year old girl was not able to be present but we showed her pictures because she is the one patient who necessitated more than one operative procedure. She suffered a 48 per cent third degree burn involving her trunk, neck and arms. She was admitted three weeks following her burn suffering a 20 pound weight loss. Her total protein was 5.8 and her haemoglobin 64 per cent. On the 34th day following admission she was taken to surgery and 6 drums of skin were taken from her legs, thighs, and abdomen below the umbilicus. Four weeks later she was again taken to surgery and another 6 drums of skin taken from her thighs, popliteal spaces and the same abdominal donor area. Following her second skin grafting she suffered massive collapse of her right lung. All of the skin took and she was

Preoperatively care is taken that the child has a haemoglobin of 75 per cent or better and twelve hours preoperatively the child is placed on penicillin which we feel has improved our percentage of primary closures. Postoperatively the children are cup fed on fluids for three weeks, nothing is permitted to enter the child's mouth, the haemoglobin is maintained and penicillin is continued for five days. The sutures are not removed unless they still remain at the end of a three month period.

Four cases of partial palatal defect were shown and fifteen patients with complete harelip and palatal defect were demonstrated.

Palates and lips repaired unsuccessfully primarily tax the surgeon far more than the initial repair. To increase the length of the palate and give a satisfac-

FIG. 4. L. R. SINGLE HARELIP PREOPERATIVELY
L. R. HARELIP FOLLOWING REPAIR

tory functional as well as anatomical result, a flap elevated from the pharynx, based upward and attached to the freshened inadequate soft palate, has been the procedure of choice.* The flap is left attached unless the patient complains of difficulty in breathing or the accumulation of nasal discharge. In such instances the flap is transected anytime after six months following elevation. This procedure cannot be successfully used on a child under three years of age.

Three cases using the posterior pillars for additional length were demonstrated.

Five cases with pharyngeal flap were present. A. B. was the youngest present having had a left sided harelip repair at the age of 6 weeks, a palatal repair at the age of 13 months and a pharyngeal flap at 3½ years of age.

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* Arch Surg, 1930 (March) 20: 453–472

neck, and a Thiersch graft to his axilla. He later had a Thiersch graft to his thigh aad agaia to further relieve contracture of the axilla. To his lip and chin he again had a full thickness graft and a Z-plasty to his axilla. More recently, he has been having an ear constructed.

H. T. Was burned with acid and suffered from contracture of the neck and left axilla. He had a draining fistula from his frontal sinus and loss of vision and scarring of the left eye. By a Z-plasty to his neck, swinging a flap from his forehead to cover a draining sinus, a skin graft to his face, an enucleation of his eye and stent grafts to the lids be has become fairly presentable and at the present time is having an ear constructed.

E. Griffin was seen in 1936 suffering from contracture of the neck, axilla and forearm. Her face was bound to her chest. By the use of split thickness and full thickness skin grafts she has, in four operative procedures, achieved complete extension of her arm, and considerable freedom of function in the region of her mouth, chin, and neck.

HARELIP AND CLEFT PALATE REPAIR

Doctor Padgett presented about thirty five cases of harelip and cleft palate defects that had been repaired. These cases were illustrative of our routine procedures in so far as primary repair is concerned and our method of handling certain problems of secondary repair.

Our initial repair of the harelip is usually performed when the infant is ten days of age providing the tissues are of good quality. The age has been selected because the infant has had an opportunity to fully expand his lungs, the red count high at birth has not yet fallen, the clotting time which is prolonged during the period of jaundice is normal and, as indicated by weight gain, the infant is better able to withstand anaesthesia.

A routine type of Mirault-Blair repair is performed. Care is taken to slightly over correct the nose in respect to elevation and inversion of the ala. Silk suture Dekanatel 0000 is used for the skin and 00 for the mucous membrane of the lip. Postoperatively the sutures are washed with a solution of 50 per cent alcohol and boric acid. The infants are fed with a cup. Transfusions as needed to keep the haemoglobin above 80 are given.

Six patients with single harelip repair were shown.

The age group ranged from two months to sixteen years.

The double lip is corrected in much the same manner as illustrated. This bilateral (Washington) procedure gives complete correction at the initial operation. In cases with a marked premaxillary protrusion the vomer is sectioned, a v shaped piece of bone removed, and the vomer reapproximated with fine silver wire suture.

Five patients with double harelip and palate repair were shown. Two cases of double harelip without palatal defect were present.

The cleft palate routinely is repaired at about 18 months of age by the Diffenbach von Langenback procedure. A couple of sutures are placed superiorly on the nasal side to bring together the palatal mucosa and fibrous raphe, and then the palate is closed with double whipping stitches. No packs are left in the lateral incisions.

Fig 5C B F Bilateral Cleft Lip Following Repair

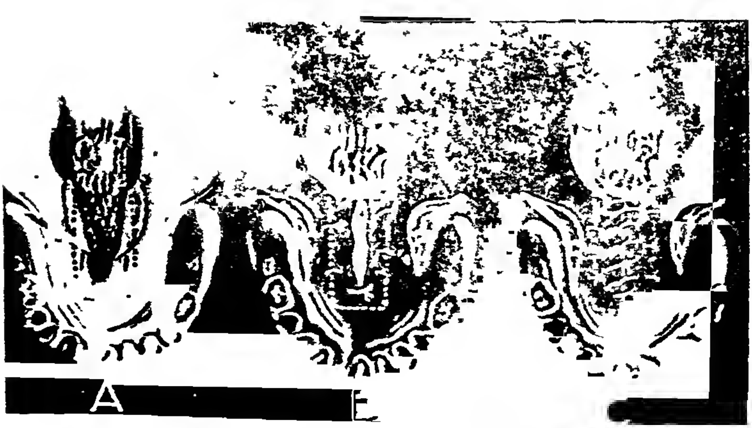

Fig. 6. Diagramatic Representation of Pharyngeal Flap

FIG. 5A. B. F. BILATERAL CLEFT LIP PREOPERATIVELY

FIG. 5B. B. F. PROFILE VIEW POSTOPERATIVELY

reconstruction. Briefly, we feel that the penis may be covered by free split-thickness grafts or scrotal flaps. The former type is usually the best, especially in total loss of skin, but scrotal flaps may be used to advantage for smaller losses. The chief disadvantage is that these flaps contain hair. Abdominal and thigh flaps are too bulky and also contain hair. Loss of the entire scrotal surface is best replaced with thigh flaps. The testes primarily are buried in the subcutaneous tissues under the skin of the upper inner thighs. When inflammation and edema subsides, thigh flaps, based on the groins near the scrotal margins, are outlined, partially raised, and sutured back in place. In about 2½ weeks, these flaps with testes contained are raised and rotated medially, suturing the two sides together in the midline to make the new scrotal sack.

Another point we feel should be mentioned is that a urethral stricture may be corrected by insertion of a stent graft. A few years ago Dr. Padgett corrected an anterior stricture by this method and the patient has a good result to date. We would like to see this procedure tried more often.

Case 1. (K C) This man lost nearly the entire skin from the shaft of his penis due to a tractor accident There was a short cuff of the inner surface of the prepuce remaining This was sutured to the skin of the pubic region and a sliding flap from the scrotum was utilized for most of the coverage The result has been satisfactory.

Case 2 (D. L) This patient was brought in to us the day after his accident in October 1944 He had been bounced from the seat of his tractor landing astraddle the power take-off His clothes were caught in the revolving gears and torn from him along with the entire skin of his penis and scrotum An associate, as Dr. Padgett was out of town, placed the bared penis under an abdominal flap for protection and buried the testes in the subcutaneous tissues of the upper inner thighs About one month later, the penis was removed from under the abdominal wall and covered by split grafts of 016 inch in thickness At the same time flaps were outlined in the upper inner thighs In 3 weeks these flaps containing the testes were elevated, rotated medially, and sutured together in the midline The raw donor sites of the flaps were covered by split grafts The newly fashioned scrotum is large enough and looks surprisingly like a scrotal sack but, of course, without dartos muscle it cannot contract A urethral fistula near the base of the shaft was closed nearly a year later by inverting surrounding skin A perineal urethrotomy to divert the urinary stream was made and kept open for 10 days, utilizing a Foley catheter A catheter was also placed in the urethra, a practice we think probably wrong as it incites infection

Case 3 (L R) For traumatic loss of skin this man had had the shaft of his penis covered by a large abdominal flap before he came to us This huge fatty mass was reduced in two procedures by Dr Padgett and the result, although still large, is functionally good

DEFORMITIES AND ABNORMALITIES OF THE JAW

Various corrections for deformities or abnormalities about the jaws are demonstrated in the following cases. First, we will show some patients who had ankylosis of the temporomandibular joint. Of 21 such cases we have treated, one-third were false ankyloses and the remainder true bony unions These are not rare but one man rarely sees a great number. Dufourmentel and Darcissac reported the largest series to date with 100 cases Infection and trauma are the

If the hard palate has been unsuccessfully repaired by the usual methods a cheek flap has been swung into the defect in some cases. Often a prosthetic device is recommended and satisfactory speech obtained. A prosthesis and a pharyngeal flap attached to the remnants of palatal tissue often can be used together to give occlusion and yet provide for the flexibility necessary for good speech. In about fifteen cases arm flaps have been used. The arm flap is elevated and the superior pedicle lined with skin. After a two week period it is attached to the rim of palatal tissue and three weeks later the flap transected and attached anteriorly.

L. M. illustrates a palate and lip unsuccessfully repaired elsewhere at the age of three. At the age of sixteen (1933) a flap was tubed from her left arm and elevated. At that time she also had a pharyngeal flap and plastic procedure on her nose. In the following year she had a Abbé flap from her lower to her upper lip and two years later the lip was rerepaired, the columella readjusted, a rib cartilage transplanted to her nose and the pharyngeal flap was transected.

In repaired lips in which there is inadequate or scarred tissue with deformity, several methods commonly employed have been used. A multiple Z-plasty procedure and a Gillies type of excision of tissue at the junction of the vermilion border and the skin most frequently are employed. An Abbé flap swung from the lower to the upper lip has often been used to give additional fullness and occasionally in the repair of a large central defect which demanded a base of the nostril as well as columella an arm flap has been used. In repairing these deformities the nose is first corrected and then the lip adjusted. Partial excision of the columella in order to balance the nostrils along with an excision of a semilunar piece of tissue from the nostril may be indicated. A Joseph's rhinoplastic procedure or cartilage transplant have often been used to achieve the desired results when the nose was markedly deviated or flattened.

Two cases with Abbé flap transplants were shown. M. M. illustrates an adult who needed a rerepair of the lip and had an incomplete repair of the palate. A routine Diffenbach-von Langenbach operation and pharyngeal flap procedure was done. A Joseph's type rhinoplasty procedure with transplantation of an Abbé flap from the lower to the upper lip improved his facial deformity.

Doctor Padgett had operated about sixteen hundred individuals for harelip and cleft palate.

SURFACE LOSSES OF PENIS, SCROTUM AND URETHRA

The following cases[1] were presented to some of this group last June in Montreal. Denudation of the penis and scrotum presents difficult problems for

[1] For details and illustrations of the following cases refer to our previous report: "Loss of Coverage of the Penis, Scrotum, and Urethra" *Plastic and Reconstructive Surgery*, vol. 1, No. 1, pp. 58–68.

FIG. 7

FIG. 8

FIG. 7. CASE 1—JAWS
X-ray showing massive bony hypertrophy
FIG. 8. CASE 4—JAWS
Before Operation

FIG. 9

FIG. 10

FIG. 9. CASE 4—JAWS
Pedicle transferred to neck
FIG. 10. CASE 4—JAWS
Final Result

left mandible and neck below. The scar was excised and a sequestrum of the mandible removed. A tubed pedicle was raised from the neck and pectoral region and, after delaying, it was sutured to the defect over the jaw and neck. After 2½ weeks the tube was sectioned

common etiologic agents. Involvement of the joint from infection is usually due to mastoiditis, dental infections and their sequella, suppurative arthritis with septicemia or following parotid abscess, or atrophic arthritis. The main point in treatment is adequate resection of the head and neck of the condyle. The interposition of cartilage, fascia, and inert metals has been tried with success but we feel that wide resection is the most important factor for success. In recurrent cases, particularly in children, the bony hypertrophy may be massive so that the sigmoid notch is obliterated and the coronoid tip is fused to the sigmoid notch and the maxillary tuberosity. Resection here may have to be done by sectioning the ramus near the angle and producing a false joint, Risdon's method. In the condylar resection landmarks may be so obscured that the danger of entering the middle cranial fossa or ear canal is real if the resection is carried out too high. We use a chisel to cut through the bone but many operators prefer upbiting rongeurs to avoid the internal maxillary artery just medial to the condylar neck. The skin incision should be far enough back toward the tragus to avoid the upper branches of the facial nerve.

Pseudoankylosis is usually the result of infection with subsequent fibrosis of the masseter or internal pterygoid. Osteomyelitis is a common cause but false ankylosis may be the result of irradiation fibrosis, atrophy with disuse, scarring on the cheek or inside the mouth from burns, other injuries, or infections. We have tried multiple stretching, prying open the jaws under anaesthesia and wiring in a wooden bite block for a few weeks. For heavy scars inside the mouth a stent graft after excising the bands is of benefit. For loss of tissue or heavy scarring, flaps from the adjacent neck, chest, or arm may have to be added.

Case 1. (G. T.) We thought you might like to see the x-rays of the girl who was operated upon by Dr. Padgett yesterday. In 1939 when 6 years old, the condylar neck was resected for bony ankylosis, the result of a mastoid infection. She was lost from follow-up until recently but states that her jaws stiffened up within six months of the operation. A solid mass of bone (x-ray) obscures all landmarks about the joint and fills the sigmoid notch. Dr. Padgett elected to do the Risdon operation you saw yesterday.

Case 2. (C. G.) Temporomandibular ankylosis in this boy followed a car accident at the age of 8. He was operated upon twice before Dr. Padgett was called in, the first time an arthroplasty being performed and the second time a resection of the head and neck of the condyle, both times being promptly followed by a recurrence. Stretching forcibly was tried several times without success. We feel that attempting stretching in the early cases of true ankylosis only aggravates bony hypertrophy. Dr. Padgett resected the head and neck and inserted cartilage in the gap but had his effort followed by ankylosis within 6 months. A Risdon operation (section through the ramus) was then performed and the result has been excellent. There is considerable retrusion of the chin and deviation of the face despite the cartilage implant alongside the body and symphysis of the mandible inserted 3 years ago. This could be done again to advantage.

Case 3. (A. G.) (Slides only) Last year we resected the head and neck of the ankylosed condyle in this little girl and inserted a tantalum cup over the distal end of the bone. She has retained good function. When last seen in the clinic in August she could open her jaws to 2.5 cm. but the cup had tipped a bit sideways and was palpable just under the skin.

Case 4. (A. W.) This woman was heavy irradiated 5 years before she came to us for what had been said to be a sarcoma of the neck. She came to this hospital over a year ago with almost no opening of her mouth. There was a scarred irradiated area over the body of the

FIG. 7

FIG 8

FIG. 7. CASE 1—JAWS
X-ray showing massive bony hypertrophy
FIG. 8. CASE 4—JAWS
Before Operation

FIG 9

FIG 10

FIG. 9. CASE 4—JAWS
Pedicle transferred to neck
FIG. 10 CASE 4—JAWS
Final Result

ft mandible and neck below. The scar was excised and a sequestrum of the mandible moved A tubed pedicle was raised from the neck and pectoral region and, after delaying, was sutured to the defect over the jaw and neck. After 2½ weeks the tube was sectioned

Fig 11. Case 6—Jaws
Final Result

Fig. 12

Fig 13

Fig 12 Case 10—Jaws
Before Operation
Fig. 13. Case 10—Jaws
After Operation

and the unused portion reimplanted in the neck. The bony gap in the body of the mandible augments motion and could be corrected but irradiation necrosis of the bone ends would nullify union and, as function is good, we will not do this procedure.

Case 5. (E. N.) Nine years ago a large sequestrum was removed from the left mandible of this woman. She had had osteomyelitis following a severe dental infection. A few

months after the dead bone was removed a cartilage graft was inserted alongside the body of the mandible. These procedures were performed elsewhere. She came to us to see if the large depressed area on the left side of the mandible could be corrected. X-ray examination showed a bony gap of 2.5 cm. Dr. Padgett inserted a bone graft, L-shaped and measuring 4 x 3 x 1.5 cm., taken from the iliac crest at the anterior superior spine. After wiring in the bone the teeth were wired in occlusion. It has been 16 weeks now and the wires are ready to be removed. An x-ray 5 weeks ago showed fair callus. The contour is good.

Case 6. (W. B.) This boy was admitted as an emergency in March 1943. This chin had been shot away by a shotgun blast a few hours before. The symphysis and parts of the body of the mandible were missing and bird shot and bone fragments were shattered through the middle of the face with perforations through the palate into the nasal cavity and both antra. The tongue was detached and severely lacerated. I helped Dr. T. G. Orr with the emergency operation. After cleansing and minor debridement we drilled holes through the proximal firm parts of the mandible near the angles and fixed a heavy coat

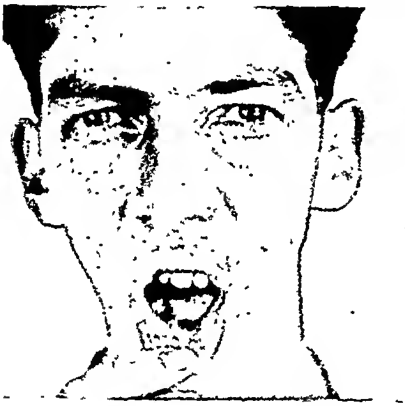

FIG. 14

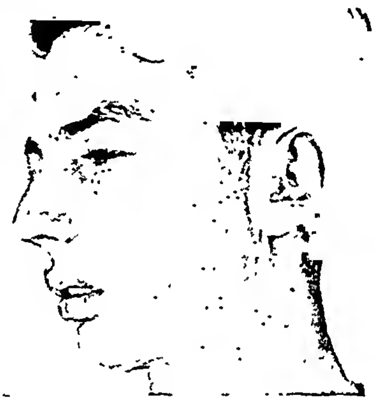

FIG. 15

FIG. 14. CASE 11—JAWS
Showing stent graft
FIG. 15. CASE 11—JAWS
After Cartilage Insertion

hanger wire through these holes, making an external loop. This kept the mandilble from collapsing inward and was used as a means of keeping the tongue forward by tying to the loop a tongue suture. The soft tissues of the chin remaining could be loosely closed.

About one year later, reconstruction was begun by Dr. Padgett. Flaps from the neck and chest and a bipedicled one from the scalp were shifted to rebuild the chin and lip. He wears a prosthesis between the bone ends at the symphysis to maintain form for the chin and to keep the bone ends from collapsing. This is removable.

Case 7. (C. C.) Early last month this boy was injured in a motor accident, suffering multiple fractures of the face and a left Colles fracture. Both zygomatic complexes were knocked downward and backward, both infraorbital rims were depressed and comminuted, and the antral walls were driven backward. The palate was sagging with an open bite. Dr. Padgett first elevated the zygomata by Gillies' method, then, opened both anthra through the canine, raising the bones with a blunt instrument in each antrum. The infraorbital rims were clevated and the comminuted bone molded by the fingers into po-

FIG. 11. CASE 6—JAWS
Final Result

FIG. 12

FIG. 13

FIG. 12. CASE 10—JAWS
Before Operation
FIG. 13. CASE 10—JAWS
After Operation

and the unused portion reimplanted in the neck. The bony gap in the body of the mandible augments motion and could be corrected but irradiation necrosis of the bone ends would nullify union and, as function is good, we will not do this procedure.

Case 5. (E. N.) Nine years ago a large sequestrum was removed from the left mandible of this woman. She had had osteomyelitis following a severe dental infection. A few

tendons. We covered the denuded finger with a direct abdominal flap and the result has been good with full flexion and extension even though the tendon sheath was missing over the tendons.

Case 3. (J. S) In July this boy came in within an hour after a dynamite cap he was playing with exploded in his hand. The palmar distal half of the thumb was avulsed as was the palmar surface of the index finger from the proximal interphalyngeal flexion crease out. The nail and distal dorsal portion of the finger were also missing but the bones and tendons were intact. After cleansing and debridement, a direct short abdominal flap was sutured to the thumb and a tubed pedicle was fashioned into which the denuded index finger was inserted. The flaps were sectioned in 17 days and, although still too large and in need of revision, the boy has a useful thumb and index finger.

Case 4. (W. D.) For over two years this man had had a painful ulcer in the palm of his hand, the result of x-ray therapy. There was considerable scarring over the thenar eminence and motions of the thumb were markedly limited. We excised the scar and sutured in a direct abdominal flap which was sectioned in 2½ weeks. A revision to remove excessive bulk was done in 3 months and the final result is good. The patient objects to the hair and excessive fat in the palm of the hand but he can use his hand well without pain. Abudction of the thumb is not perfect but much of the thenar area was scar tissue.

Case 5. (W. M.) In March of this year this man came to us with a huge basal cell epithelioma over the sacrum. We removed this by cauterization and after the slough was cleaned up and the granulations were in good condition we covered the whole area with three complete drums of skin. The take was good except for the area immediately over the sacrum. To cover this, a large tubed flap was raised from the left loin. The lower end on the abdomen was delayed once, then, this foot was sutured to the sacral defect after removing the scar tissue from the base of the ulcer. In three weeks this flap was resected and the cut end reimplanted in the back just above the first skin graft. We may need to use this tissue later if there is a recurrence

Other than the above summarized cases shown three large translight exhibits illustrating repairs of various nasal deformities were demonstrated. These contained approximately fifty cases and there was another translight presentation of four cases in various stages of total ear reconstruction. Further, two cases with extensive hemangiomas of the face and their ultimate results after skin grafting were presented, showing the slides before surgery.

sition Packs were placed in the antra and removed after 12 days The teeth were wired in occlusion by a simple technique To keep the middle of the face up, a wire loop through a drill hole in the symphysis was drawn up tightly to a coat hanger wire arm from a plaster head cap, utilizing the madible as a splint for the maxilla Immobilization and position, as well as occlusion, are good and the result we think will be good

Case 8 (V H) A similar middle of the face fracture is presented in this boy This fracture through the base of the nose and both maxilla procuded a downward sagging of the palate 1 cm Intermaxillary wiring was applied and a large rubber strap (Penrose drain to a plaster head cap) beneath the chin pulled up the mandible against the maxilla The fracture was adequately reduced and maintained He says he looks just the same as he did before

Case 9 (L O) This man's prognathism was marked (slide) Our method of treatment here was to cross cut the ramus and pull back the anterior section of the mandible, wiring the teeth in the desired occlusion The point of the chin was moved backward about $\frac{3}{4}$ of an inch The ramus was cut with a Gigli saw, the skin incision being just behind the angle The profile shows the recession to have been adequate and this fellows's appearance is improved

Case 10 (J Mc) (Slides only) This boy was killed in action in Europe He had a markedly retruding chin for which a large cartilage from the costal margin was inserted through an incision beneath the chin The cosmetic result shows a decided improvement

Case 11 (N S) Several years ago Dr Padgett removed a sequestrum, the result of osteomyelitis, from this boy's mandible During the interim to last spring when he was seen again, his chin had retruded markedly We inserted a large piece of costal cartilage which has brought the chin out considerably Because of no labial sulcus to hold in a lower plate, we placed one month ago, a large stent graft in front of the symphysis He now has a deep skin lined sulcus and is having a plate constructed

SKIN FLAPS

We use skin grafts wherever possible to correct scars and surface defects and losses but certain injuries and certain areas require the addition of more tissue for function and appearance Flaps are often necessary for coverage on hands and feet if tendons or bones are exposed The next group of cases are ones in which we employed flaps of various kinds for different situations Our direct cross leg flaps were reviewed in the presentation at the Western Surgical Meeting in 1944 [1]

Case 1 (F B) This man had a painful ulcer on the ball of his foot, the result of a fluoroscopic burn in the famous California disaster from which many of you have had cases The ulcer had been present since the time of the injury 5 years before Last May we placed a cross leg flap to the bottom of the foot and he now walks without pain He still has to take care not to allow much pressure on the flap for long as sensation has not yet returned Because of his poor general circulatory status we did not cut and apply this flap directly but delayed it once This was fortunate as 1 inch was lost in the delaying procedure

Case 2 (B H) Last June, this little girl had a rope burn of the palm of her hand The flesby part over the proximal phalynx of her little finger was avulsed, baring the flexor

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1 For details and illustrations of cases shown by slides other than the above cases, refer to "Use of Skin Flaps in Repair of Scarred or Ulcerative Defects Over Bone and Tendons" *Surgery* 18 287–298, September 1945

July 1947

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

ABSTRACTS OF CURRENT LITERATURE

EXPERIMENTAL WORK

Medawar, P. B.: A Second Study of Behaviour and Fate of Skin Homografts in Rabbits. *J. Anat. 79:* 157, Oct. 1945.

A previous systematic survey on the problem of the homograft by Medawar showed that the intensity of the homograft reaction, measured in terms of the time of survival of homologous grafted skin, depended upon: (1) the dosage of graft borne by the recipient ("dosage phenomenon"); (2) the recipient's previous experience of grafting from the same donor source ("immunity phenomenon"), and (3) a measured but casually unanalyzed element of genetic diversity.

It was further shown that the homograft reaction is absolutely specific toward foreign as opposed to native skin, and relatively specific toward the skin of the donor. In the present investigation four new technics of transplantation were used on 201 rabbits, namely: (1) transplanting grafts on raw areas just large enough to receive them (fitted grafts); (2) transplanting fitted grafts to the shank; (3) grafting to both sides of the body simultaneously; and (4) operating upon baby rabbits.

These methods and the possible deductions from the experimental observations are described and discussed in considerable detail.

BOOK REVIEW

"Acrylics And Other Dental Resins," by Stanley D. Tylman, M.S., D.D.S., and Floyd A. Peyton, Ph.D. (published by J.B. Lippincott Company) is an authoritative appraisal of the historical development and multiple uses in modern dentistry and reconstructive surgery of that group of resins first introduced in America in 1937, and designated acrylics. Here, in an easily readable format, clarified for reference with many definitive subheadings and illustrations, is a concise handbook on the newest plastic materials for dental and surgical prosthesis. Special emphasis, of course, is focused upon the acrylics.

Part One of the book, written by Dr. Peyton, treats in detail the history of dental resins. It makes the interesting point that the progressive use of restorative materials in dentistry has paralleled the chronicles of the creative arts and industries of the world. Subsequent chapters give an over-all picture of the most widely used synthetic dental resins and related materials. The reader is familiarized with their physical and chemical nature, as well as with their specific clinical characteristics.

Part Two, written by Dr. Tylman, deals entirely with the clinical applications of synthetic resins. Actually, this section of the book is a practical, "how-to-do-it" clinical manual of the many functions which the acrylics perform in both restorative dentistry and reconstructive surgery. The dentist will find much of interest in the chapters which discuss the acrylic inlay, acrylic-resin crowns, fixed bridges, complete dentures, repairs and replacements. The plastic surgeon will be more concerned with the wealth of material describing the rôle of the acrylics in somatoprostheses—to name only a few, the artificial ear, eye, nose, finger, hand, and arm—for all of which the acrylic materials have been used with most successful results.

Together, Dr. Peyton and Dr. Tylman have produced a book which earns a place in the library of any one whose work lies in the field of reparative dentistry or surgery. The lucid text and the numerous illustrations combine to make it a guidebook to the most effective present-day techniques of restoration.

Reviewed by
C. R. Straatsma, M.D.

rabbits produced a just perceptible immunity toward homologous grafted skin. This skin immunity was not related to red cell agglutinins. It is therefore likely that the leucocytes were responsible for the feeble skin immunity resulting from the massive intravenous injection. This was confirmed as small intradermal injections of leucocytes in saline suspension produced a complete immunity toward skin later grafted from the donor of the blood to its recipient. It is therefore concluded that red cells and skin share, at the most, very few antigens between them; that leucocytes create an immunity to skin when grafted intradermally; and that eighteen times the dosage of leucocytes effective intradermally is barely effective when transfused intravenously. Leucocytes are therefore assumed to share antigens in common with the skin cells.

Medawar, P. B.: The Experimental Study of Skin Grafts. *Brit. Med. Bull. 3:* 79, 1945.

The common methods of covering very extensive raw areas are reviewed by Medawar. Of the two "discontinuous" grafts, pinch and patch grafts, the latter is preferable because of the absence of scarring in the donor site. In the third method large raw areas are covered by repeated "milking" of one donor site.

The problem of the patient with very extensive raw areas has been solved by the use of autografts. But experience in the use of homografts, the third possibility, has, on the whole, been disappointing although occasionally when used as a temporary cover, they have been claimed to be life-saving.

Experimental observations have shown that homografts are always destroyed in due course; even the collagen fibres of the homograft being eventually dissolved away. In not one of 800 trials with 800 distinct pairs of rabbits has a homograft been considered as successful. The reaction provoked by the homograft is governed by at least seven antigens freely combined among at least 127 skin transplantation groups. The time of survival of skin epithelium in a homograft varies with the amount of skin that is grafted. The larger it is, the shorter is the period of survival. A second dose of homograft survives a much shorter time, a matter of days. There is evidence that the antibody acts upon some constituent of the nucleus—possibly the genes themselves—and inhibits nuclear division. Nuclear division normally takes place in 4 to 6 days after grafting, and this is the time at which second dosage homografts die.

It is pointed out that when homografts are used as a "discontinuous" graft (pinch or patch grafts) they can provide cover for only a negligible proportion of the raw area seen in extensive wounds, and that a second dosage has a negligible survival time. Therefore the only type of homologous graft which can provide a cover for a reasonable period of time is a fitted graft, which covers the whole raw area.

If the baby rabbit is any guide, the human baby is just as resistant to skin homografts as the adult. It may not be worth while to use homograft dressings on patients who have received transfusions of whole blood with living leucocytes previously. Unless the homograft reaction is rigidly tissue-specific (which is unlikely) and rigidly specific toward the tissues of the particular donor (which is known not to be the case) then the "transplanted" leucocytes may generate an immunity toward transplanted skin. Furthermore, in view of the rhesus antigen, no homograft dressing should be applied to a woman of child-bearing age.

Medawar comments on graft glues with special reference to the use of fortified plasma, that is, plasma with its fibrinogen content artificially raised, and thrombin.

On the effects of temperature he points out that the lower the temperature, the less enzymic autolysis occurs, and the less risk of loss from infection. The length of time which skin can survive in the absence of nutrition is a function of its temperature—at least within the physiological range of 0 to 37 degrees Centigrade. Therefore, the classical fixation of grafts by pressure dressings, while favoring capillary ingrowth and therefore nutrition, also favors an earlier death of the free graft from autolysis by raising the temperature of the graft as a whole to that of the body. If the graft were left open and exposed to the cool air, the rate of vascularization would not be significantly affected, for the graft bed would be at body temperature. This room temperature would favor the maximum survival of the superficial layers of the graft.

The general hypothesis of the immune reaction produced by homografts is as follows: Skin homografts always heal well during the immunologically latent period, but they are not known to survive beyond a period of weeks. The survival time is directly proportionate to the intensity of the reaction, which ultimately leads to their destruction. This time is the same for all homografts which have been transplanted from one donor to one recipient in one operation irrespective of the position of the grafts or of their local dosages in any one position; but it varies (1) with the systemic graft dosage, the more skin being grafted the more rapidly it breaks down; and (2) with the rabbit's previous grafting from a source having antigens in common with the new donor. The most important factor in the survival is that (3) grafts of a second planting break down much more rapidly than their predecessors. This represents the antigenic relationship between the donor and the recipient. If the relationship can be assumed to have a particulate and combinational basis, it is under the control of at least seven antigens freely distributed among at least 127 skin transplantation groups. Resistance to homologous grafted skin therefore belongs to the category of actively acquired immune reactions.

Among the important points of technic and deductions discussed by Medawar are the following:

The collagenous remains of the debris of the skin homograft are in due course wholly removed and replaced by new collagen fibres of native origin.

The power of reistance to skin homografts is fully developed in young rabbits of from 2½ to 4½ weeks old. The skin from these baby rabbits elicits at least as strong a reaction as the adult skin after transplantation to an adult recipient.

Grafts of a uniform population, whether they lie in the same operative field or are distributed about the body, break down simultaneously and in histologically identical fashion irrespective of the position they occupy, their local dosage in that position, their size, number or manner of grafting.

It is therefore inferred that the homograft reaction is systemic in nature, and that the systemic component is the only significant component of graft dosage.

Since "fitted" grafts do not grow by outward spread and proliferation of epithelium, their initial graft dosage remains approximately constant. These "fitted" grafts are found to survive longer than grafts of the same initial dosage, which increase cumulatively by epithelial outgrowth.

The reality of the "dosage phenomenon" is thus confirmed. Strictly paired tests show that a second fitted graft transplanted from the same donor to the opposite inside of the same recipient 12 to 16 days after the initial graft, undergoes a highly accelerated retrogression. This further confirms the reality of the "immune phenomenon."

The following working hypothesis of the homograft reaction is presented: The antibody generated by skin homografts is such that it prevents the formation of nuclear division in the cells of the homologous grafted skin. The cells of initial homologous grafts therefore grow and multiply until this immunity reaction is established. A second patch of homologous graft is, however, much more rapidly destroyed, and if removed for examination after 12 days, it shows no nuclear division at all.

Detailed photo-micrographs and protocols of experiments are given.

Medawar, P. B.: Relationship between the Antigens of Blood and Skin. *Nature 157:* 161, Feb. 9, 1946.

Medawar found that it is not possible to graft skin between individual rabbits or individual human beings of ordinary genetic diversity, with permant success. Skin so grafted is destroyed by a reaction conforming grossly to that of an active acquired immunity. The relationship between the immunological properties of blood and other tissue is not yet clear. Two distinct questions require an answer: Does the transplantation of foreign homologous skin commonly result in the formation of red cell agglutinins? And does the transplantation of blood ever lead to immunity toward skin later grafted from the blood donor? Forty independent trials have given a uniformly negative answer to the first question. The second is more difficult to answer, because immunity to skin homografts is not yet recognizable by a test tube or other *in vitro* reaction.

A massive transfusion of whole blood to

fact is found in the dramatic clinical improvement which follows prompt closure of the wound, and split-skin grafts including a proper thickness of the important derma are preferred. Early closure and healing are delayed primarily because sloughing tissues are slow to separate, and powerless to combat infection; thus contracture continues in the open wound and skin grafting is impossible. Therefore, the early removal of slough and the presence of an acceptable surface for skin grafts are of prime importance. Earlier the authors had reported on their work with experimental animals, and the purpose of this article is to describe this method adapted to man, with evidence from clinical data.

The method described is based upon the premise that the separation of slough is hastened when the pH on the surface of the wound is lowered, pyruvic acid being found to be the most acceptable agent. It is applied liberally as a thick paste after mixture with cornstarch in the manner described in detail in the original article. In a burn involving the entire lower leg from the knee to the ankle about 3000 cc. of the paste should be applied. An occlusive covering of vaseline gauze is placed over the paste to prevent drying, and blisters should be opened only to expose slough; but preliminary cleansing or surgical "debridement" is not necessary. Since separation of the slough proceeds from the margins, large areas are incised, without the use of anesthesia, to create more "margins" within the slough. Further detailed description of the initial and subsequent dressings is included, and sedation before dressings are applied is advocated although the amount of pain is variable.

Four clinical cases are presented in detail, with illustrating colored plates. The first patient presented deep thigh burns in which the slough had not separated after application of vaseline pressure dressings for 20 days. Six days after application of pyruvic acid paste the slough was separated and split-skin grafts were applied successfully. In the second case deep electrical burns of an arm and both legs were covered with pyruvic acid paste on the second day. All slough, including large sections of burned muscle tissue, had disappeared by the thirteenth day and split grafts applied. In the third case an area of second degree burn which showed early demarcation and separation of the slough was complete by the fifth day, and despite 5 additional days of treatment with the paste the burn epithelialized spontaneously from uninjured islands of epithelium. The final patient was an 8-year old child with severe burns of both lower legs. The first pyruvic acid dressings were applied 3 days later, and 10 days after the burn all slough had separated and the granulation surface was acceptable for grafting.

It is evident that following applications of pyruvic acid paste slough separates rapidly, without significant damage of living tissue. These wounds are immediately acceptable for extensive skin grafting regardless of the presence of bacteria, as indicated by culture. This method speeds the ultimate objective in the treatment of deep burns, namely, the early closure of the wound.

Editorial Comment: This article presents a practical method with startling clinical results, and deserves the careful study of all those who realize the tremendous importance of early closure of burn wounds.

GRAFTING

Macomber, W. B., and Patton, Henry B.: The Split Thickness Graft—a Useful Adjunct in Tube Pedicle Preparation, *Surg. Gynec. & Obst. 84:* 97 Jan. 1947.

A method of preparing a tube pedicle is described by Macomber and Patton to help in preventing the occurrence of complications which may delay its use or destroy valuable tissue. They suture a split-skin graft into the donor site beneath the tube, thereby eliminating the excessive tension and the undermining of tissue sometimes found necessary in other methods of closing the area.

The possible complications which the authors seek to prevent are:

(1) Infection, which may be caused by (a) separation of the angles, (b) separation of donor site sutures, (c) wide undermining, (d) hematoma formation secondary to undermining, and (e) excessive use of suture material.

(2) Decreased blood supply and possible necrosis of the tube due to undermining near each end of the tube.

(3) Lowering of the patient's resistance

Fixation of graft glues plus methods for obtaining "cool surface" grafts thus have a confirmed physiological background.

Editorial Comment: By his experimental work Medawar has given us some fundamental information on many important grafting problems, especially the survival and practicability of homografts. It appears that the longest any initial homograft is likely to survive is from 3 to 5 weeks, and that a second homograft begins to die about the fifth day. If these figures hold good for human beings as for rabbits, and for babies as for adults, it is clear that homografts can have very little value in the cases in which they have previously been used, that is, in cases of very extensive areas of skin loss which cannot be given more than a partial cover of homografts in any one operation.

Peer, L. A.: Experimental Observations on the Growth of Young Human Cartilage Grafts. *Plastic & Recon. Surg. 1:* 108 July 1946.

Experimental evidence that young autogenous cartilage grafts tend to increase in size following transplantation is presented by Peer. All forms of autogenous cartilage survive transplantation and are not subject to invasion or absorption.

This work is based on examination of 15 autogenous rib, septal and ear cartilage grafts buried in 8 infants. These grafts were examined at intervals of 12 to 27 months following transplantation. There are charts which show small but definite increases in size of the young transplants.

The author offers the following explanation for the mechanism responsible for the growth of the cartilage grafts:

(1) Increase in size may be due to division of cartilage cells, with elaboration of a matrix substance about each cell, thus increasing both the bulk of the graft and the number of cellular components.

(2) Increase in size of the graft could arise from activity of the connective-tissue cells surrounding the grafts by elaboration of a matrix substance about each cell and its incorporation in the graft structure.

Peer also describes a method of microscopic examination of fresh cartilage grafts by immersing them in melted paraffin.

Editorial Comment: In his numerous communications on the behavior of the cartilaginous transplants, Peer has contributed greatly to our knowledge of supporting materials in reparative surgery. The present paper on the growth of young cartilage is of great practical value. It emphasizes again that autogenous grafts are the only material to be used in the young if growth of the transplant is expected.

McCarthy, Miles D., and Perkins, William H.: Comparative Efficacy of Blood from Normal and from Burned Donors in Experimental Burns. *Arch. Surg. 53:* 570 Nov. 1946.

For years clinicians have postulated the presence of a circulating toxin in burned patients, but experimentally a transfusion from a burned animal to a normal animal is generally well tolerated by the latter. In McCarthy and Perkins' work with a series of 48 rats, a standard thermal burn was applied to one group under anesthesia, resulting in a mortality of 44 per cent in the controls. Blood from other burned rats was ineffective as a transfusion in treating the first group submitted to the standard thermal burn. However, a similar group of rats with the standard burn (44 per cent mortality in the untreated controls) showed no mortality when transfused with normal blood. Thus, the group infused with the post-burn blood showed a survival rate similar to that of the untreated controls, while the animals transfused with normal blood showed a significantly higher survival rate. Further observations indicated that increased mortality is not a direct result of increased hemo-concentration, but plasma potassium levels were slightly higher in the post-burn blood than in the normal blood.

BURNS

Connor, Gervase J., and Harvey, Samuel C.: The Pyruvic Acid Method in Deep Clinical Burns. *Ann. Surg. 124:* 799 Nov. 1946.

The prompt closure of the wound in deep clinical burns is emphasized by Connor and Harvey. For the general condition of the patient is determined, in a large measure, from the open condition of the wound after the initial systemic consequences are controlled in the first few days. Proof of this

That cancellous bone grafts were rapidly vascularized, and that they are osteogenic in their new sites were indicated both by clinical and microscopic observations.

Certain technical features of the operative procedures (obtaining and implanting the grafts and postoperative care) are discussed.

Editorial Comment: Numerous reports on the use of cancellous bone in the restoration to facial contour appeared during the war years. Use of cancellous bone as a filling material has been unanimously accepted. The advantages in its employment as a nasal support have not yet been sufficiently proved.

Derma (de-epithelized skin) is generally considered an excellent filling material, rarely producing a reaction but often showing a tendency to shrink when used with a fatty layer. The latter is absorbed to a great extent.

Preserved cartilaginous grafts (from other individuals or a cadaver) usually show a tendency to become absorbed in various degrees.

Clarkson, Patrick; Wilson, T. H. H., and Lawrie, R. S.: Treatment of Jaw and Face Casualties in the British Army. *Ann. Surg., 123:* 190, Feb., 1946.

Clarkson, Wilson and Lawrie report on a large number of maxillofacial war casualties which were treated in the British Army. They give an excellent account of the types of cases encountered, the therapeutic methods employed, and the results obtained. Since the report deals only with war casualties treated under war conditions, considerable attention is given to such matters as army policies and changes in them necessary for the effective care of such patients.

The value of this work to the peace-time surgeon lies in its following features: One thousand cases of a wide variety of maxillofacial injuries formed the basis for the report. The pathologic and therapeutic problems connected with such injuries are well described. The principles and methods of treatment followed were of sound and recognized quality. Some of the notable principles of treatment which have been reemphasized are here outlined.

I. *Early Care of the Maxillofacial Injury.*—General: Debridement, conservative but adequate, with minimal sacrifice of viable tissue; prompt control of hemorrhage; prompt fixation of bone fragments; primary closure of wounds; maximum esthetic repair (without jeopardy to later reconstruction); and diligent wound care during the first few days.

Pharyngeal Wound: Debridement and closure in layers when possible; tracheotomy if respiratory embarrassment is at all likely; and if closure is non-feasible, debridement and packing, and conversion into pharyngotomy.

Comminuted Mandible: Careful, judicious debridement and wound closure; dependent counter drainage often not necessary.

Wounds Involving Antrum: Nasal antrotomy; debridement of bone and mucosa; closure, if possible.

Jaw Fixation: Time: promptly, except in cases in which respiratory embarrassment necessitates delay; method: any of the recognized expedient methods.

Tracheotomies: Performed without hesitancy on patients with existent or impending respiratory embarrassment.

Damaged or Involved Teeth: Policy of conservatism, preserving teeth that can be salvaged and those which aid in immobilization of bone fragments.

Feeding: Tube feedings required in only 4 per cent of the cases. Gastrostomies very rarely necessary.

II. *Later Care of Maxillofacial Fracture.*—Adequate continued fixation of bone fragments until healing ensured; sequestrectomies and drainage as needed; secondary hemorrhage occasionally, but usually can be controlled.

Bone Gaps: Use of cancellous bone grafts, a simple and safe procedure.

Scars: Early revision possible with chemotherapy.

Trismus: Preventable often by enforced motion. Some anesthesia and a regime of appropriate postoperative motion required for some patients.

Angle Fractures of Mandible: Displaced posterior fragment must be reduced and immobilized. Such fractures with teeth in fracture line unite slowly.

Condylar Fractures: Immobilization in

through loss of blood, prolonged surgery, and morbidity due to the enlarged operative field from undermining.

The proposed flap is undermined down to the deep fascia between two parallel incisions, which determine its width. The flap is then tubed until closure is prevented by slight tension at each end. The graft, .025 to .030 inches thick, is sutured into position, care being taken that the skin edges are accurately approximated. At each corner, direct tailoring of the graft is necessary to prevent overlapping, thereby maintaining normal skin tension. Macomber and Patton state that they used this method routinely for all tubes except those of the neck.

Baxter, H., and Elvidge, A.: Plastic Repair in an Electrical Burn. *Canad. M. A. J., 56:* 202, Feb., 1947.

A case of severe electrical burn which caused extensive loss of the scalp with underlying skull and dura, is reported by Baxter and Elvidge. The patient also had a gangrenous foot and leg, which necessitated amputation.

A craniectomy was performed about 2½ months after the accident. An area of dead bone, about 5 inches in diameter, was removed. A fascial graft taken from the thigh was placed over the dural defect, and a protective dressing applied. Three and a half months after the accident a large pedicle graft was raised from the lower abdomen and eventually transferred on the wrist to the head. Four months later the patient was re-admitted to the hospital, when a large tantalum plate was placed beneath the pedicle flap. When seen two years later he reported that he had had no further trouble. The case demonstrates the use of a fascial graft, skin flap and tantalum plate in multiple-stage operative procedures to reconstruct a severe cranial defect.

FACE AND JAW

Macomber, Douglas W.: Reconstruction of Bony Defects of the Face. *Surg. Gynec. & Obst., 83:* 761, Dec., 1946.

A general survey of the problem of correcting defects in the facial contour and jaw, based on approximately 200 operations performed on war injured, is presented by Macomber. The various materials and methods at one's disposal are discussed, special value being attached to cancellous bone grafts.

Tantalum is said to have given immediate "fair" esthetic results in correcting facial defects. However, subsequent sepsis, displacement, and the production of a cold sensation in the patient's face led the author to abandon its use.

Limited experience with *acrylis resin* as an implant material precluded its thorough appraisal, but the author feels that indications for its use are very limited.

Fascia lata as an implant was found to show little shrinkage or absorption. It is recommended for small depressions where strong protection or rigid support is not essential.

Fat showed low resistance to infection and a tendency to absorption and fibrosis. It should not be used as a free grafts but is useful in filling small shallow facial defects when attached to sliding skin flaps.

Dermal grafts (de-epithelized skin) deemed impractical for the type of defects treated were not used. It was felt that such grafts possessed no advantage over fascia grafts, and that they carried the hazard of sepsis due to their retained secreting and excreting elements, and may be partially absorbed.

It is admitted that *cartilage* has become established as the tissue of choice for correction of certain types of facial defects. The question of choice between autogenous and homogenous cartilage is discussed. Macomber has used both types with success but stresses the points that homogenous cartilage, if used, should be collected and preserved carefully according to an accepted technic, and that sepsis and tissue incompatibility are added possibilities.

To correct facial and jaw defects 117 cancellous bone grafts taken from the iliac crest were used. Recipient sites varied; some having undergone complications were areas of poor risk. The results were gratifying in that "there were no regrets, and no graft was lost." Temporary local swelling, minor fluid collections and controllable cellulitis were the only complications. Union and consolidation occurred early, and clinical firmness was usually manifest by the third week.

by approximation. The graft is cut to fit the size and shape of the defect and is placed under normal skin tension. The author uses only an occasional subcutaneous suture if the position of the graft has to be maintained. Exact approximation of the wound edges is desirable. The ear-lobe graft may be split if alar cartilage is present. A dressing should insure gentle pressure and firm immobilization. The nostrils are packed with gauze, the graft is covered with xeroform dressing, and a stent mold immobilizes the entire area. The dressing is left intact for 6 to 8 days.

In all defects, Dupertuis uses a lobe graft from each ear but the transplants are carried out in a separate stage to avoid sloughing. If a secondary revision is necessary, undermining of the graft can be done since it has its own subcutaneous tissue.

The advantage of a free ear lobe graft in addition to its suitability is the relative simplicity of the procedure as compared with reconstruction by the time-consuming pedicle graft.

Editorial Comment: This important contribution on the use of a composite graft from the ear lobe is described in minute detail and illustrated by excellent diagrams and photographs. It should be carefully read by every one interested in nasal reconstructive surgery.

Suggit, Stephen: The Repair of the Depressed Nasal Bridge. *J. Laryng. & Otol.* Vol. 60, Dec., 1946.

Five cases of depressed nasal bridge that were reconstructed by cancellous bone grafts from the iliac region are described by Suggit. The grafts were inserted through external incisions. Satisfactory results obtained were confirmed by roentgenograms showing the grafts in good position.

HARELIP AND CLEFT PALATE

Fogh-Anderson, Poul: Harelip and Cleft Palate. *Acta Chirurgica Scandinavia Vol. 94*, Fasc. III–IV, 1946.

Fogh-Anderson gives an interesting description of the management of harelip and cleft palate deformities in Denmark by his father, V. Fogh-Anderson. When a child with harelip or cleft palate is delivered, the birth is immediately reported to the Invalidity Insurance Court. Subsequently the children are summoned through the State Institute for Defects of Speech for examination, with ensuing operation, which is performed in a central hospital by Surgeon-in-Chief V. Fogh-Anderson. Now about 150 patients are treated every year by one or more operations. Dental care and speech lessons are given either in Copenhagen or in Aarhus.

The most favorable age for operation is about 2 months for harelip and 2 years for cleft palate. The age of 2 years has been accepted as the most favorable time for operation of cleft palates, since the operative mortality is rather high before that age, in particular within the first year of life, and the results of speech become correspondingly poorer the later the operation is carried out after this date.

The operation is generally performed under light chloroform anesthesia, which is found not to be harmful to young infants. Local anesthesia with novocaine-adrenalin is given to older children and adults.

The operative technic for both harelip and cleft palate is that introduced by Veau. In cases of double harelip one side is operated on first and the other 6 to 8 weeks later. If there is a difference between the two sides the broadest cleft is always treated first in order to avoid too much tension at the time of the second operation. Foch-Anderson believes that the removal of a wedge-shaped segment of the vomer results in a flattened upper lip. He finds that comprehensive mobilization and treating each side of the lip separately permit closure of the lip without removal of a segment of the vomer. Pressure from the soft tissues will put the premaxilla in place slowly but forcefully or perhaps inhibit the growth of the vomer.

Editorial Comment: This is a very comprehensive report and Dr. V. Fogh-Anderson in his management and operative repair of the harelip and cleft palate has mastered what is known by experienced men and has arrived at the frontier which still must be explored to improve our late operative results. The management of the nostril deformity in wide single harelip and that of the short columella and the nostrils in the double harelip deformity are not discussed.

Procedures advocated by the author con-

occlusion for 3 weeks; then full function allowed.

Coronoid Fractures: Intermaxillary fixation not required.

Maxillary Fractures: Immobilization by intermaxillary fixation when feasible. When immobilization not feasible, other methods resorted to, such as cast splints attached to fixed head appliance.

Weiner, L., and Wald, A. H.: Fibrin Foam and Thrombin as Used in the Surgical Removal of a Large Fibromyxoma of the Mandible. *J. A. Dental A., 33:* 731, June, 1946.

Weiner and Wald report a case in which the patient had a history of swelling in the region of the right lower first molar of six months' duration. Roentgenograms showed a multilocular area of radiolucency suggestive of multilocular cysts or adamantinoma. At operation the bicuspids were removed on this side, a flap of the mucosa was resected medially, the overlying alveolar bone was removed, and the neoplastic mass enucleated. After thorough debridement the bony defect was filled with a mixture of human thrombin, penicillin, and saline solution incorporated in a matrix of fibrin foam, over which the margins of the incision were then closed. Healing progressed uneventfully until the fifth day, when moderate swelling and pain appeared. Four injections of 20,000 units of penicillin, at 2-hour intervals, were given directly into the remnant of the fibrin foam implant. The next day the patient was asymptomatic and thereafter healing was uneventful. The pathologist's report was fibromyxoma of the mandible.

Thoma, K. H.: Ankylosis of the Mandibular Joint. *Am. J. Orthodont. & Oral Surg. 32:* 259, May, 1946.

The arguments for early operation in cases of ankylosis are given by Thoma for prevention (1) of underdevelopment of the jaw and resulting difficulties with dentition and disfigurement such as mandibular retrusion and bird face; (2) of maxillary protrusion and contraction due to use of dilators to force the jaws apart in young patients; and (3) of atrophy and fibrosis of the muscles of the jaw in patients of any age if operation is done before the ankylosis has been present for too long a period of time; and by early operation on patients of any age rampant caries is avoided.

In a series of 18 cases 2 were due to birth injury, 6 to rheumatoid arthritis, 2 to Marie-Strümpell's disease, 2 to septic arthritis, 2 to osteomyelitis, and 4 were due to malunion of condylar fractures. Of these 13 were unilateral, and 5 bilateral, the latter occurring in rheumatoid arthritis, Marie-Strumpell's disease, and septic arthritis.

Thoma advises condylectomy in all cases in which the joint has started to become ankylosed or in which arthritic processes cause pain and limitation of motion. Osteoarthrotomy is recommended if there is complete bony union. In both operations the cavity which is produced by the removal of bone is drained with a piece of rubber dam for 24 hours. In septic cases a rubber tube, such as a piece of No. 10 catheter, is inserted through the fistulous opening, if present, into the wound for the injection of a weak solution of penicillin.

Three cases are reported in some detail. One patient had a unilateral mandibular ankylosis due to rheumatoid arthritis; another, a unilateral mandibular ankylosis due to mastoiditis secondary to a fracture of the base of the skull, and the third had a unilateral partial ankylosis caused by osteomyelitis of the condyle.

NOSE

Dupertuis, S. M.: *Free Ear Lobe Grafts of Skin and Fat; Their Value in Reconstruction about the Nostril.* *Plastic & Recon. Surg., 1:* 135, Sept., 1946.

Dupertuis presents a study of free composite ear lobe grafts in reconstruction of defects about the nose, based on a total of 15 grafts done on 11 patients. He prefers the ear lobe as the donor site for these grafts of skin and fat, because he feels they are especially suitable in shape, color and texture for reconstruction of the ala, nasal tip and columella.

Attention is called to the following points in the procedure: Size and shape of the graft are first measured on the lobe of the ear. The straight portion of the lobe between the tail of the helix and the dependent curve is selected and a triangular wedge-shaped piece of ear lobe excised. The donor site is closed

(2) The flap is located in a suitable, comfortable place on the abdomen or chest. For the hand this is usually in the lower quadrant on the same side. For a volar surface defect the pedicle is up toward the thorax; for a dorsal surface defect the pedicle is down toward the inguinal region. The flap with a short broad base is cut to fit the defect but with an additional one-third allowance for shrinkage.

(3) The bed of the flap is reduced in size with sutures along the edge and the rest is grafted with a split graft.

(4) The flap is sewed in loosely among the base with a few fine sutures and is then closed around its sides with deep fine sutures and a few skin sutures.

(5) Fixation with adhesive tape and cotton waste pressure dressings is advised.

On the fingers and palm free skin grafts are preferable to flaps if they can be used. Free full thickness grafts from the neck are of value on the dorsum of the fingers to obtain the best pad. Cross-arm flaps are used when the thin skin of the arm is necessary to secure function in a finger or the thumb web.

The detaching of flaps is done in 14 to 20 days. The edge is usually sewed in accurately. Partial detaching can be done as indicated, severing part of the pedicle on two or three occasions.

Tubes are necessary for thumb reconstruction. Often flaps must be thinned.

Webster, George V.: Late Repair of Tendons in the Hand. *Am. J. Surg.*, *72:* 171, Aug., 1946.

While primary tendon repair is frequently followed by poor results, suture of extensor tendons is most apt to give good results, as pointed out by Webster. Repair of flexors is less successful; those sutured at the wrist yielding the best results; repair in the palm is less satisfactory.

The reasons for poor results in primary tendon suture are:

(1) Anatomical: The flexors are more powerful than the extensors and thus overcome adhesions which form about the extensor tendons. Absence of tendon sheaths about the extensors except beneath the carpal ligament allows more ready movement of a repaired tendon in the areolar tissues. "Straight line" pull of the extensor tendon over the dorsum of the metacarpals predisposes to good extensor function.

The flexor tendons show only slight differential motion at the wrist and separate into individual functional tendons in the palm, supplemented by the lumbrical muscles. Acting as a unit they can function although scarred. The flexors and extensors of the wrist are powerful so they tend to stretch adhesions in the flexor tendon compartment at the wrist. The tendon sheaths at the wrist are grosser than in the fingers. The pull of the flexor muscles at the wrist is also "straight line," tending to loosen adhesions.

In the palm the adhesions of a flexor tendon following primary repair are more disabling because the motion of the tendon is in direct proportion to the degree of the flexion of the finger. There are no tendon sheaths in the palm except for the little finger and the thumb and distal to the distal palmar crease for the other fingers. Repaired tendons glide in the areolar tissue. In the finger and the thumb the tendon runs in a sheath and firm tunnel. Primary repair within these tunnels is followed by swelling of the tendon and necrosis. If the sublimis tendon is removed, only the profundus is repaired and the tunnel is split or unroofed, necrosis does not occur but adhesions do form. The pull of the flexor muscle through an angle is never as effective in overcoming adhesions as it is in the palm and wrist.

(2) Bacterial: Koch has emphasized the danger of bacterial contamination. Repair in the first 6 hours has been considered of maximum safety but chemotherapy has extended the safe period up to 24 hours. However, this extended period should be used for repair of extensor tendons and flexor tendons severed at the wrist or in the palm only.

Soap and water cleansing, careful debridement, good skin preparation and aseptic operative technic reduce bacterial contamination.

(3) Surgical Errors: Wrong incisions; unnecessary trauma at operation; use of too gross suture materials; operating in a bloody field without employment of a tourniquet; institution of motion too early; and inadequate technic (suture).

Late Tendon Repair: If no initial surgery has been performed and the wound closed *per primum*, or if skilful initial surgery has

cerning which experienced plastic surgeons disagree are the proper age for operation, the Veau palate repair (a modified Langenbeck) versus the bone-flap repair (Warren Davis) and the advisability of closing the two sides of the lips separately in double harelip instead of a single stage repair.

In the United States an increasing number of plastic surgeons favor the utilization of the prolabium for the entire length of the lip in double harelip repair rather than increasing the length of the lip by means of skin flaps brought down from the maxillary processes. Dr. Fogh-Anderson does not state which of these methods he prefers.

Weaver, D. F., and Bellinger, D. H.: Bifid Nose Associated with Midline Cleft of the Upper Lip. *Arch. Otol. 44:* 480, Oct., 1946.

Weaver and Bellinger found only one case reported in the literature where a bifid nose was associated with a midline cleft of the upper lip. The patient's nose had excessive width of the bridge, measuring 4.5 cm. between the inner canthi. The lip was repaired 2 weeks after birth. The first stage of nasal reconstruction was done about 10 weeks after birth, at which time the alar cartilages and two halves of the septum were approximated, the columella narrowed and the excess skin removed.

The authors plan to wait until the child has attained complete growth before attempting to narrow the nasal bridge because of possible interference with development of the lacrimal ducts and sinuses.

Editorial Comment: Several known but unreported cases of bifid nose should be reported so the experiences of numerous surgeons can be compared regarding the most advantageous time for repair, and the operative procedures correlated.

HAND AND FOOT

Rubin, Leonard R., Major: Repair of Avulsion Wounds of the Hands and Feet by the Flap Graft. *Am. J. Surg. 72:* 373, Sept., 1946.

Use of the flap graft in repair of avulsion wounds of the hands and feet is discussed by Rubin. In hand defects the usual donor site was the abdomen, the flap base being directed superiorly or inferiorly and never cut across the midline. The flaps were thick and included all skin and fat down to Scarpa's fascia. The widest pedicle possible was used and the flaps were cut larger than the defect.

For foot defects the donor sites were the anterior, lateral and medial aspects of the thigh. The base of the flap was usually placed superiorly but an occasional retrograde flap was used. The flaps were delayed when necessary.

In the recipient site only frankly necrotic tendon and bone were excised before a flap was placed over the defect. All granulation and early scar tissue were removed. Fresh skin edges were cut and undermined to facilitate suturing. By this means the size of the defect can also be decreased.

Brown, James B.; Cannon, B.; Graham, W.; Lischer, C.; Scarborough, C. Parke; Davis, W. B., and Moore, A. M.: Direct Flap Repair of Defects of the Arm and Hand. *Ann. Surg., 11:* 706, Oct., 1945.

According to Brown *et alii*, direct abdominal and chest flaps, which comprise the principle of a short broad pedicle, allow complete mobilization and immediate use. This saves time in comparison with the tube flap method. The crippled extremity is freed of its scar by dissection and the flap is prepared at the same time. The arm or hand is planted under the flap and in 2 to 3 weeks it can be detached from the abdomen. Then deep work on bone, nerve or tendon can be done. These direct flaps may be used within the first few days of the original injury; tendon and bone fragments can be saved and bone union advanced.

The diagnosis and recording of arm and hand injuries are important, a separate notation on each finger being required. Sensation in the fingers is of paramount importance, for the decision of trying to save or remove fingers may depend on its presence. The use of the following simple charting method is suggested:

Fingers are designated by number—1 2 3 4 5
Joints are designated by letter—A B C
Metacarpals and phalanges by—W X Y Z

Technic: (1) The open wound is prepared or the scarred area is resected so that an adequate blood supply is present.

the great toe on the opposite side is the best digit for substitution.

Operative Procedure: A U-shaped flap is turned distally at the base of the second toe, and both dorsal arteries are divided. The extensor tendon is cut high, the periosteum is reflected in a cuff and the bone divided. A transverse incision is made across the finger stump, the extensor tendon is located, the periosteum reflected and the bone end refreshened. The bone of the finger and toe are approximated by suturing the reflected periosteal cuffs. The extensor tendons are sutured so that the suture line is proximal to the periosteal closure. The skin flap is sutured to the skin of the finger, and a plaster cast is applied. In one month the volar attachment is divided and the flexor tendon sutured.

Havrahow, Edward M.: The Split Thickness Skin Graft as a Covering Following Removal of a Fingernail. *Surgery 20:* 398, Sept. 1946.

Havrahow recommends split graft to replace the nail where the fingernail and its radix must be removed. He claims that the graft resembles a nail in appearance.

MISCELLANEA

Brown, J. B.; Cannon, B.; Lischer, C.; Davis, W. B., and Moore, A.: Surgical Substitutions for Losses of the External Ear: Simplified Local Flap Method of Reconstruction. *Surg. Gynec. & Obst. 84:* 192, Feb., 1947.

Brown *et alii* outlined a relatively simple method for reconstruction of the external ear in patients in whom enough surrounding scalp tissue is present.

Whatever is left of the stump of the auricle is freshened and implanted under a scalp flap above and behind the ear. When union is firm (in 2 to 3 weeks) a piece of preserved costal cartilage in the desired shape is put under the scalp flap. In another 3 to 4 weeks the flap and cartilage are dissected free from the skull so as to leave soft tissue attached to the under-surface of the flap and the skull. The resultant double raw surface is covered with a single large thick split-skin graft. A small tubed flap from the immediate neck region can be added for a helix but is seldom necessary.

By this plan, losses of the helix and pinna can be repaired in two operations, and total reconstruction of both ears has been done in as little as three operations. The authors recognize these restorations as substitutions and concentrate on the size, general shape and the direction of the reconstructed ear. They feel that a general outline and prominence may at least fail to attract attention.

Thoma, K. H.; Smith, H. W.; Rosco, H. F., and Goldman, H. M.: Miscellaneous Case Reports. *Am. J. Orthodont. & Oral Surg. 32:* 282, May, 1946.

The following cases are described in detail by Thoma and his colleagues.

A 47-year old man was treated successfully for a comminuted fracture of the horizontal ramus of the right mandible by circumferential wiring of the jaw around a Gunning split of acrylic material.

A 45-year old woman with a compound fracture of the right horizontal ramus into the mouth, with displacement of the posterior fragment, was treated by a transosseous wiring of the fragments and application of Jelenko splints to the upper and lower arches, with fixation first by elastics and then by wire. Following the open reduction the molar tooth in the line of fracture was extracted as were also the lower right central incisor and a root in the premolar region. Two days later x-ray examination showed that the posterior fragments had again become displaced. Five days after the open reduction its revision was carried out. It was found that the fragments could slide over each other, shifting the wire which made it possible for the posterior fragment to displace upward. The fragments were wired together again, but this time with the wire running perpendicular to the line of fracture. The course was uneventful following the second operation.

A 52-year old man with a compound fracture of the right mandible in the mental region and a subcondylar fracture on the left was treated by transosseous fixation of the two fragments in the mental region with 22-gauge stainless steel wire, by extraction of two teeth, and the insertion of a Steinmann pin through the anterior portion of the man-

been done but non-function results, the chances for repair are best. If infection has occurred, foreign bodies remain or surgery has been poor or multiple, late tendon repair offers little hope. Some of these conditions can be improved by scar excision and replacement by a pedicle flap.

Fingers with stiff joints, severed nerves and serious defects are unsuitable for late tendon repair. In many of these instances amputation must be considered.

A hand with flexible joints, intact nerves and good circulation has the best prognosis for late tendon repair but even this rarely yields perfect return of function. Results should be evaluated in one year to 18 months.

Technic: (1) A bloodless field is secured by placing of a pneumatic cuff tourniquet about the upper arm. Allow a 10-minute rest period each hour.

(2) Plan incisions. Extensor tendors are exposed via two or more transverse incisions; flexor tendons in the finger via mid-lateral incisions dorsal to the digital nerves and vessels; in the palm, through a palmar flap along the flexion creases, and in the wrist through transverse incisions.

(3) Remove all deep scar. Be prepared to use a graft for closure.

(4) Open sheaths from the side to preserve the volar gliding surface.

(5) In the palm, the sublimis tendon is routinely excised and effort is concentrated on the profundus tendon. In the wrist, excision of scar alone is frequently all that is necessary.

(6) Extensor tendons are exposed and repaired by simple approximation.

(7) A segment of palmaris longus tendon is useful as a graft for shortened tendons.

(8) Flexor tendons are repaired by direct approximation in the wrist and hand, tho wrist being flexed during healing. If retraction is severe, a tendon graft is used.

(9) In the fingers, tendon repair of the flexor almost always requires a graft.

(10) Severed nerves should be repaired wherever possible.

(11) Closure of wounds should be without buried sutures in subcutaneous tissue. Approximate the skin edges carefully.

(12) Pressure dressings and splints are used to maintain the position of a relaxed tendon at rest.

(13) Postoperatively the arm is elevated. Circulation of the fingers is checked, and the first dressing is applied on the eighth to tenth day when sutures are removed.

After-Care: Do not move the repaired tendons for 3 weeks. Active exercise is begun from 4 to 6 weeks. Then active and passive exercises and physiotherapy are instituted. Time and willing cooperation by the patient are major factors in successful results.

Young, Forrest: Transplantation of Toes for Fingers. *Surgery 20:* 117, July, 1946.

In the opinion of Young, the indications for replacing lost fingers partially or completely are for the most part cosmetic. One can get along well with three fingers as long as the thumb is intact. However, since loss of a thumb causes great disability, numerous methods have been used to restore the thumb. These include prosthesis, phalangization, rotary angulatory osteotomy, tubular pedicle graft with inserted bone grafts, transplantation of index finger to the position of the thumb, and digital transplantation from either hand or foot. The prosthesis is fair cosmetically but is insensitive, and troublesome to keep on. Tubed graft of the skin and subcutaneous tissue with a bone graft can elongate a finger. However, the skin is never of the same color or texture, and there is no nail. Transplantation of a toe comes closest to fulfilling the requirements of appearance and function.

Nicoladini conceived the substitution of toes for fingers in 1900, in using part of the second toe for a partial defect of the finger. Various other cases have since been reported. While Bunnell condemns digital transplantation, others report some good results.

Finger reconstruction should be limited to losses of such a nature that the transplanted toe can restore normal length. The best digit for substitution is the second toe on the same side. Failure results if the patient cannot bear the irksome position for the necessary 3 to 4 weeks. Premature division of the pedicle causes loss of the toe or poor circulation, predisposing to atrophic changes and scarring. Even if tendons are united, active motion is not assured, but fair sensation returns. For losses of the thumb from the metacarpophalangeal joint, transfer of

3 years before. X-ray examination showed a multicystic tumor expanding the mandible and extending from the right first premolar to the subapical area of the left first molar. By removing the bone anterior to the tumor mass it was possible to enucleate the entire mass with the teeth *in situ* except for the last two teeth, which tore away when the tumor was removed. The mandibular nerve was preserved on the left, but the bone was removed on the left side of the symphysis, where the roentgenogram had shown invasion. On the right the tumor cavity extended under the second molar, and in the attempt to extract this tooth the jaw was fractured at the symphysis where the bone was very thin. A hole was drilled in the remaining part of the lower border at this place in each fragment, and the fragments were impacted and held firmly by transosseous fixation. Fibrin foam and thrombin were used for hemostasis; the wound was closed with a drain in the cavity to take care of any bleeding that might occur. The postoperative course was uneventful. The drain was removed on the second postoperative day, and the patient was discharged on the fifth postoperative day. Pathologic examination showed fibromyxoma of the mandible.

A 46-year-old woman was admitted with a history of a removal of an adamantoblastoma 4 years before. This had recurred, and biopsy made a few days before entry was diagnosed as adamanatoblastoma. The patient had a large swelling in the region of the angle of the left mandible, about 10 x 10 cm. in size. X-ray examination showed an osteolytic central defect at the angle of the jaw, with evidence of resorption at the posterior part of the inferior and superior borders of the jaw extending well into the ascending ramus. The lesion was resected by first making an incision anterior to the ear and performing an osteotomy in the subcondylar region. The condyle was left in to serve later as an attachment for a bone graft. The lesion was exposed through a curved incision running from behind the angle of the jaw almost to the chin. The mandible was cut through near the mental foramen with a Gigli saw, and the lesion as well as the mandible with the buccal mucosa involved were removed. In doing this the internal maxillary artery was torn and a considerable amount of bleeding resulted. An acrylic resin prosthesis was then inserted and wired to the anterior fragment after the wound into the mouth had been first closed. Postoperatively the oral wound opened with a sloughing at the edges, and later at the anterior end of the skin incision a large amount of fluid-like substance was removed. Neither this wound nor the intraoral wound would heal. Finally the acrylic splint was removed, the intraoral wound was closed, and a Dakin's tube was inserted in the extraoral fistula. Penicillin was given locally as well as intramuscularly. The condition then took an uneventful course.

A 40-year old woman complaining of a canker sore of 1½ months duration was shown by biopsy to have carcinoma of the alveolar process and hard palate on the left. An ulcerated lesion was present which extended from the third molar region to the second premolar and to the midline of the hard palate. A roentgenogram revealed destruction of the maxilla in the region of the extracted first molar and a rounded cyst-like mass in the floor of the right antrum. Under pentothal sodium intravenous anesthesia with an intratracheal tube inserted through the nose and a postnasal plug to close the passage, the teeth on the left side of the maxilla were extracted and the carcinoma destroyed by fulgeration. Postoperatively the patient did well and was given penicillin troches to control the odor from the slough. Pathologic examination of the specimen revealed epidermoid or squamous cell carcinoma, grade II.

Thoma, K. H., and Blumenthal, F. R.: **Heredity and Cyst Formation.** *Am. J. Orthodont. & Oral Surg.*, *32:* 273, May, 1946.

The pedigree of a family with a tendency to the development of dental cysts is given by Thoma and Blumenthal. Twelve members of this family in three generations are known to have developed dental cysts of one sort or another—globulomaxillary cysts, dentigerous cysts, follicular cysts and a parodontal cyst. In many cases the cysts were multiple. The case histories and roentgenograms on five of these patients are given.

dible. To the latter were attached Frac-Sure rods, which in turn were attached to a plaster head cap. Postoperative recovery was uneventful.

A 38-year old man with a submaxillary abscess due to acute pericoronitis was treated successfully by extraction of the involved teeth and two aspirations of pus from the abscess cavity, followed by instillation of penicillin into the cavity.

A 46-year old man was treated for chronic osteomyelitis of the horizontal ramus of the mandible by sequestrectomy and saucerization and did well postoperatively. After the second postoperative day, on which he was discharged from the hospital, he took penicillin orally four times a day on an empty stomach, in a 50,000-unit dosage.

A 15-year old boy entered the hospital with a ranula which he had first noticed in the floor of his mouth 2 months before. Three months prior to entry he had been kicked in the lower jaw while playing football. At operation a cyst membrane was found to lie directly under the covering of the mucous membrane. When this was penetrated another cyst was found. The second smaller cyst was excised, and the periphery of the first cyst was sutured to the floor of the mouth. Besides some edema in the floor of the mouth and difficulty in swallowing the course was uneventful.

In a 6-year old boy a dentigerous cyst of the maxilla was found at operation to be formed from the follicle of the first permanent incisor, which had not erupted. The thin cyst membrane was detached from the bony wall until it remained attached only at the neck of the incisor. While the incisor was held in place with an instrument, the membrane was excised from around the tooth and removed. The two deciduous incisors were then extracted. The postoperative course was uneventful, but the second as well as the first incisor erupted out of their normal positions. The orthodontist who was consulted recommended that the teeth be banded in about 6 months and aligned in proper occlusion.

A 13-year old boy entered the hospital with a mass in the left maxilla, which had been present for 5 years. He also had irregularity of dentition, and in the year before entry the growth of the mass had produced deviation of the nasal septum. Before operation a free-flowing dark brown fluid was obtained at aspiration of the mass indicating that it was a dentigerous cyst. The cyst extended into the maxillary sinus and at operation a mesiodens was found in it. The cystic membrane was enucleated in one piece with the mesiodens. The intraoral wound was closed after an opening had been made into the nose beneath the inferior turbinate bone and the cavity had been packed with petrolatum-impregnated gauze. The postoperative recovery was good. The pathologic examination showed that the cyst was a dentigerous one formed from a mesiodens.

A 42-year old man entered the hospital with a diagnosis of adamantinoma of the jaw. X-ray examination showed a cystic lesion of irregular outline and with a poorly defined margin. It extended approximately from the first molar on the left to the first molar on the right, causing a thinning of the cortex of the inferior border and a displacement of the canine and second premolar teeth on the left. At operation the cyst sac was found filled with creamy cholesterol and was removed in one piece. It was necessary to extract the four mandibular incisors; and because the root tips of the right canine and left premolar extended into the cavity, these two teeth were also extracted. The pathologic report was odontogenic cyst of the mandible. The patient made a normal recovery.

A 7-year old girl was admitted with a chief complaint of swelling of the gingiva in the lower incisor region, which she had first noticed 2½ months previously. Examination showed a firm, purple mass, 2 x 3 cm., extending over the occlusal surfaces of the teeth in the region of the lower left lateral incisor. X-ray examination showed a large area of bone resorption around an unerupted lower left second incisor extending to the region of the central incisor. With an endothermy knife the tumor was excised along with the lower right central incisor and unerupted lateral incisor. With the exception of an elevated temperature on the first two postoperative days, the postoperative course was uneventful. The pathologic report was giant cell tumor.

A 24-year old man entered the hospital with a swelling of the mandible anteriorly and to the left, which he had first noticed

3 years before. X-ray examination showed a multicystic tumor expanding the mandible and extending from the right first premolar to the subapical area of the left first molar. By removing the bone anterior to the tumor mass it was possible to enucleate the entire *mass with the teeth in situ except* for the last two teeth, which tore away when the tumor was removed. The mandibular nerve was preserved on the left, but the bone was removed on the left side of the symphysis, where the roentgenogram had shown invasion. On the right the tumor cavity extended under the second molar, and in the attempt to extract this tooth the jaw was fractured at the symphysis where the bone was very thin. A hole was drilled in the remaining part of the lower border at this place in each fragment, and the fragments were impacted and held firmly by transosseous fixation. Fibrin foam and thrombin were used for hemostasis; the wound was closed with a drain in the cavity to take care of any bleeding that might occur. The postoperative course was uneventful. The drain was removed on the second postoperative day, and the patient was discharged on the fifth postoperative day. Pathologic examination showed fibromyxoma of the mandible.

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Bowers, Warner F.: Chlorophyll in Wound Healing and Suppurative Disease. *Am. J. Surg.*, *73:* 37, Jan., 1947.

The use of water-soluhle derivativea of chlorophyll in a wide variety of wounds and diseases is described by Bowers. He reports on his own experience together with that of a group of over 30 officers in treating more than 400 lesions over a period of 9 months.

The plastic conditions of 6 patienta were treated, in addition to such lesions as pilonidal cyst wounds, fistula-in-ano, tumor clean-up, ulcerative colitis, thoracic empyema, gunshot wound sinus tracts, burns, decubitus ulcers, compound fractures, and many urologic and eye, ear, nose and throat diseases.

The mode of action of chlorophyll is aa yet ohscure, but the beneficial effects are apparently due to its direct antihacterial activity in relation to secondary saprophytic and proteolytic organisms, and to its rather marked stimulating effect exerted on the tissue cells of the host. The latter effect ia demonstrated grossly by the very rapid formation of granulation tissue of an unusually firm and fine texturc. A review of the literature relating to the chemistry, pharmacology and bacterial action of chlorophyll is included.

Bowers found that the rapid stimulation of granulation tissue was a disadvantage in certain plastic cases in which the profusion of granulation tissue interfered with the procedure of skin grafting, while in other cases chlorophyll dressings wero used to induce a granulating bed suitable for skin grafting.

Greeley, Paul W.: Plastic Surgical Problems Related to Orthopedics. *Proc. Inst. Med. Chicago*, *16:* 296, Jan. 15, 1947.

The majority of plastic surgical problems arising in orthopedics are those involving cutaneous defects and scar contractures, according to Greeley. Failure to solvs these prohlems stems from the lack of understanding of the characteristics of, and ths indications for, the different types of skin grafts. The author therefore includes a list of fundamentals to be kspt in mind when a skin graft is selected, namely:

(1) Thin split-thickness grafts (Thiersch) are the most certain to grow hut will give ths poorest functional and esthetic result.

(2) Split-thickness grafts of intermediate thickness, i.e., 40 to 60 per csnt total skin thickness, are most useful for ths majority of extensive cutaneous defects such as those following burns.

(3) Thick split-thickness skin grafts furnish many of the characteristics of ths fres full-thickness skin graft and are useful in replacing scar contractures of the neck, axillae and dorsum of the hand when a good aubcutaneous fat pad is present in ths recipient area.

(4) Free full-thickness or Wolfe grafts give the maximum degree of functional and cosmetic result but are the most difficult to make grow. They are used primarily in covering cutaneous defects of the face and the flexor surface of the hands and fingers, where a maximum degree of elasticity and surface resistance is desired.

(5) Free skin grafts should always be given preference where the recipient hed is covered with a good subcutaneous fat pad upon which pressure dressings can bs applied.

(6) Pedicle flaps, direct or tubed, ars utilized primarily (a) when both lining and covering are needed, as in reconstructing jaw and cheek defects; (b) when it is necessary to carry some subcutaneous fat with the skin graft, as in covering exposed tendons or other deeper structures; and (c) when covering a major defect of an extremity in which one plans to reopen the skin graft later in order to correct underlying pathologic conditions of bone, tendon or peripheral nerve.

THE PROBLEM OF DECUBITUS ULCERS IN PARAPLEGICS[1,2]

JOSEPH G. KOSTRUBALA, M.D. AND PAUL W. GREELEY, M.D.

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Of the several complications of paraplegia, bedsores are the most chronic, confining the patient to bed and requiring prolonged and meticulous care. Like extensive burns, bedsores are the avenues through which the patient loses considerable amounts of proteins which must be replaced. The superimposed infection of the ulcers contributes further to production of general debility.

Some ulcers can be induced to heal with scar tissue formation, by employing various agents to combat infection in conjunction with rigid attention to diet to maintain satisfactory nutrition. This method is applicable to smaller ulcers and even then success cannot always be attained. Months and even years would be required to heal some ulcers. When healing eventually does take place by secondary intention, the resultant scar is adherent to the underlying bone, is extremely unstable and, when subjected even to insignificant trauma, has a tendency to break down and ulcerate. Obviously such conservative treatment is debilitating, and discouraging to the patient and surgeon alike.

In 1945 a few reports were published on early plastic closure of bedsores. The work was done in military hospitals, and various methods were used. Each however, entailed excision of the entire pyogenic membrane, and closure by mobilizing adjacent skin to cover the defect. It would be interesting to have an opportunity to review these early cases to determine the stability of the transposed skin at this time.

It is not necessary to go into the etiology of the decubitus ulcer in a paraplegic but the following facts need stressing. The ulcers nearly always develop over bony prominences and most frequently about the pelvic girdle; namely, over the sacrum, trochanters, ischial tuberosities, and, less frequently, over the anterior superior iliac spines. Experience proved that simply excising the entire pyogenic membrane and repairing the defect so produced, by mobilization of adjacent normal skin, would not remove the immediate cause of pressure ulcers, and that the new skin, when subjected to trauma, would ulcerate in a manner similar to the original decubitus formation. The importance of removal of the bony prominences was later confirmed by the microscopic study (fig. 1), which in all cases indicated changes from simple fibrosis to chronic osteomyelitis, even though this could not always be demonstrated clearly by x-ray studies prior to the operation. Thus it is obvious that complete excision of the ulcer must include the removal of a considerable portion of the underlying bone, to effect simultaneously the elimination of the infection and the projecting portion.

[1] From the Division of Plastic Surgery, Department of Surgery, U. S. Veterans Administration Hospital, Hines, Illinois.

[2] Presented at the Annual Meeting of the American Association of Plastic Surgeons Memphis, Tenn., May 7, 1947.

It is necessary to digress at this point to mention briefly the micropathology of the ulcer itself. There is a definite line of demarcation between the normal epithelium and the ulcerous membrane. The membrane itself is made up of deeply staining necrotic material, below which is found a layer of granulation tissue. In the more chronic ulcers, between the necrotic membrane and the granulation tissue, there is found a layer of avascular tissue, pale staining and resembling collagenous material. Underlying the granulation tissue, there is an extensive layer of fibrous scar tissue (fig. 2).

FIG. 1. MICROPHOTOGRAPH OF A SECTION OF THE GREATER TROCHANTER REMOVED AS A PART OF THE SURGICAL TREATMENT OF A DECUBITUS ULCER

The bone marrow is mostly replaced by fibrous tissue. There is round cell infiltration and one small artery shown presents a hypertrophy of the wall. The veins are uninvolved.

The most striking changes are noted in the arteries. The walls of these vessels are markedly thickened (fig. 3). All coats are involved but the muscularis shows the greatest hypertrophy. At times only the intima shows proliferative changes. The lumen of the artery is gradually diminished and eventually may become completely obliterated. Similar changes in the arteries are found in the bone underlying the floor of the ulcer. No such changes are noted in the walls of the veins.

Patients selected for surgery are those who have attained an adequate state of nutrition and in whom the ulcer presents locally a well-developed pyogenic membrane without any associated acute infection. Penicillin in 100,000 unit doses every three hours is started on the evening before the day of operation. This is continued postoperatively until all the sutures are removed, which is within 10 to 15 days. Sulfasuxadine, in 6 gm. doses three times a day, is given for a week prior to the operation on all ischial ulcers. Recently paregoric in

FIG. 2. MICROSCOPIC SECTION THROUGH THE PERIPHERY OF A DECUBITUS ULCER

There is an abrupt line of demarcation between the normal appearing granulation tissue and the ulcer membrane. The membrane itself is made up of four distinct layers. The most superficial is made up of deeply staining necrotic material. Below this a pale staining collagenous layer is observed. The third layer is principally made up of chronic granulation tissue. The fourth and deepest layer is composed of scar tissue.

FIG. 3. MICROPHOTOGRAPH OF A SECTION OF THE ULCER MEMBRANE SHOWING VASCULAR CHANGES

Although the veins are not involved, the arteries present striking changes characterized by hypertrophy of the walls. All the coats are involved but the muscularis shows the greatest hypertrophy. At times only the intima shows proliferative changes. The lumen of the artery is gradually diminished and eventually may become completely obliterated.

two-dram doses daily was given to effect some constipation where ischial decubiti are to be operated on.

The surgical procedure varies according to the requirements of each case, but in general we have evolved the following technique:

An incision is made around the opening of the ulcer in normal skin well beyond the ulcer edge. By sharp dissection the pyogenic membrane is excised, from the periphery to the center until the bone is encountered. The projecting bony prominence is then reduced with an osteotome. In the case of trochanteric ulcers, the greater portion of the trochanter is removed with a chisel and the edges are smoothed with a bone rasp (fig. 4). The ischial tuberosity is similarly partially amputated. In repairing sacral decubiti it is necessary to level off only the small bony prominences which are easily palpable.

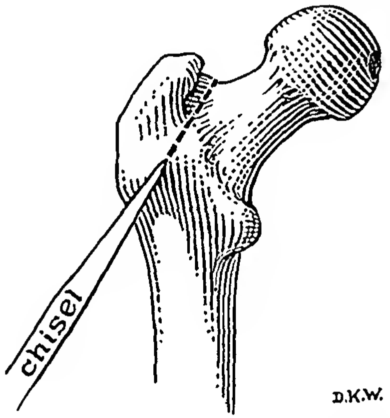


FIG. 4. DRAWING SHOWING THE METHOD AND THE AMOUNT OF BONE REMOVED IN THE SURGICAL TREATMENT OF A TROCHANTERIC DECUBITUS ULCER

The entire trochanter is properly exposed and radically removed with a chisel or an osteotome. This procedure does not weaken the remaining bone, but it does remove the prominence which etiologically contributed to the formation of the ulcer. Elimination of such bony prominences minimizes the possibility of recurrences.

The size of the defect is measured, and a direct skin flap, larger than this area, is elevated from a previously selected adjacent donor site. The flap is planned to be rotated through no more than an arc of 60 degrees (fig. 5-6). Before this flap is transferred to its new position the bony bed is covered by a flap of muscle and fascia in the ischial lesions, and by fascia alone in the trochanteric and sacral cases. This flap serves as an immediate covering of the bone and as an intermediate layer between the bone and the fat tissue of the skin. This forms a pseudo-bursa which helps to keep the skin flap from adhering to the bone and also aids in filling the dead space. The free end of the flap is sutured to the remaining periosteum about the stump of the trochanter or the ischial tuberosity.

The skin flap is next rotated over the defect and sutured to the base and edges, using 00 chromic catgut subcutaneously and interrupted silk sutures for the

FIG. 5. APPEARANCE OF A SACRAL ULCER, REPAIRED ELSEWHERE BY "S" PLASTY

It is widely undermined and surrounded with poorly vascularized skin. A suitable flap was delineated and partly elevated

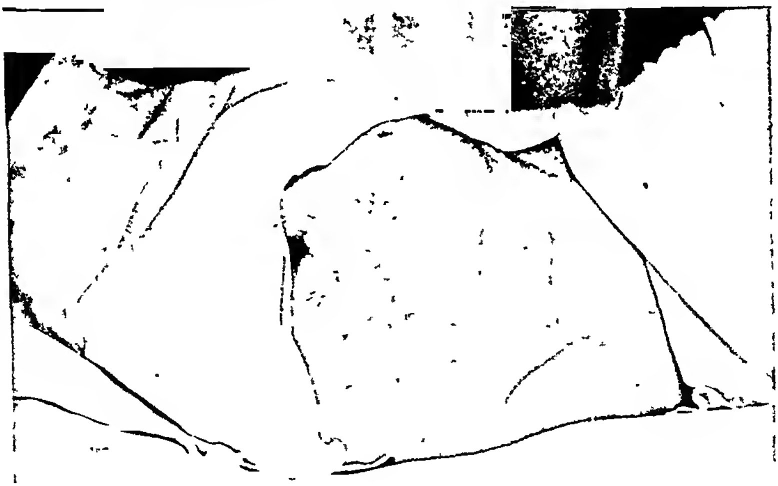


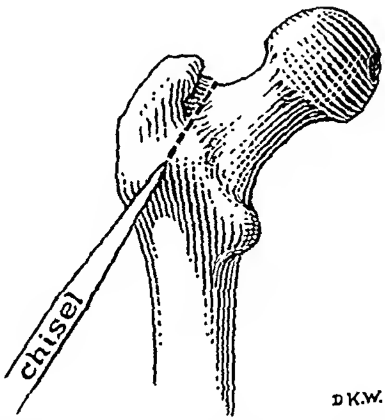
FIG 6 POSTOPERATIVE PHOTOGRAPH OF PATIENT SHOWN IN FIG 5

The operation was performed six months previously. The patient is active and participates in the entire program of rehabilitation.

two-dram doses daily was given to effect some constipation where ischial decubiti are to be operated on.

The surgical procedure varies according to the requirements of each case, but in general we have evolved the following technique:

An incision is made around the opening of the ulcer in normal skin well beyond the ulcer edge. By sharp dissection the pyogenic membrane is excised, from the periphery to the center until the bone is encountered. The projecting bony prominence is then reduced with an osteotome. In the case of trochanteric ulcers, the greater portion of the trochanter is removed with a chisel and the edges are smoothed with a bone rasp (fig. 4). The ischial tuberosity is similarly partially amputated. In repairing sacral decubiti it is necessary to level off only the small bony prominences which are easily palpable.



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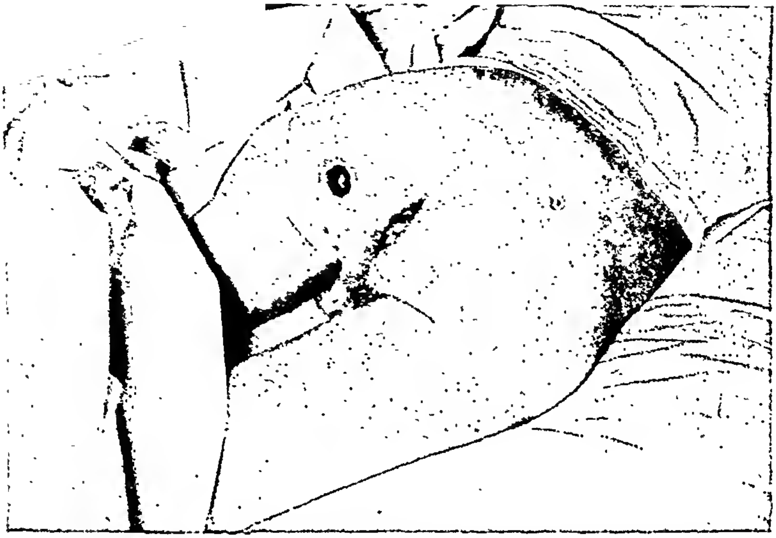

FIG. 9. A TYPICAL ISCHIAL DECUBITUS ULCER, WIDELY AND DEEPLY UNDERMINED PRESENTING THE APEX OF THE ISCHIAL TUBEROSITY. SEE FIG. 10

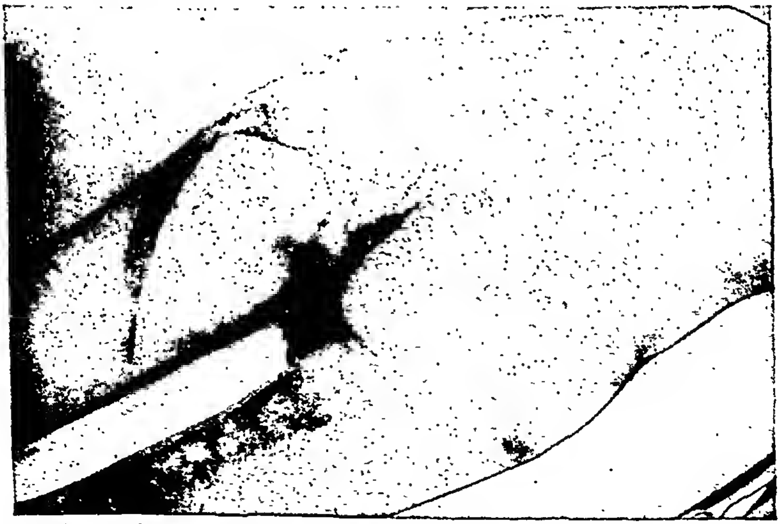

FIG. 10. POSTOPERATIVE PHOTOGRAPH OF THE PATIENT SHOWN IN FIG. 9

The excision of the ulcer included a radical amputation of the tuberosity, covering of the amputation stump with a rotary flap obtained from the Biceps Muscle and covering with a skin flap. This was a one stage operation.

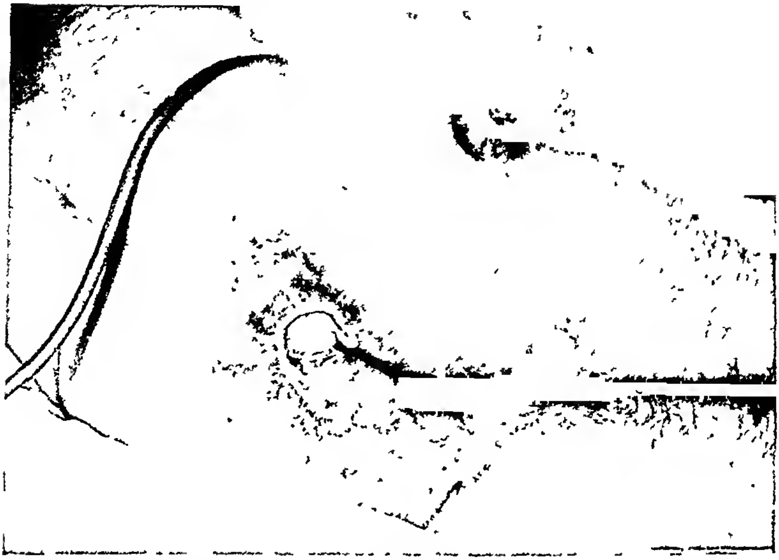

FIG. 7. AN EXTENSIVELY UNDERMINED SACRAL DECUBITUS ULCER OF 14 MONTHS DURATION

In addition to this lesion this patient has similar but smaller ulcers over both trochanters

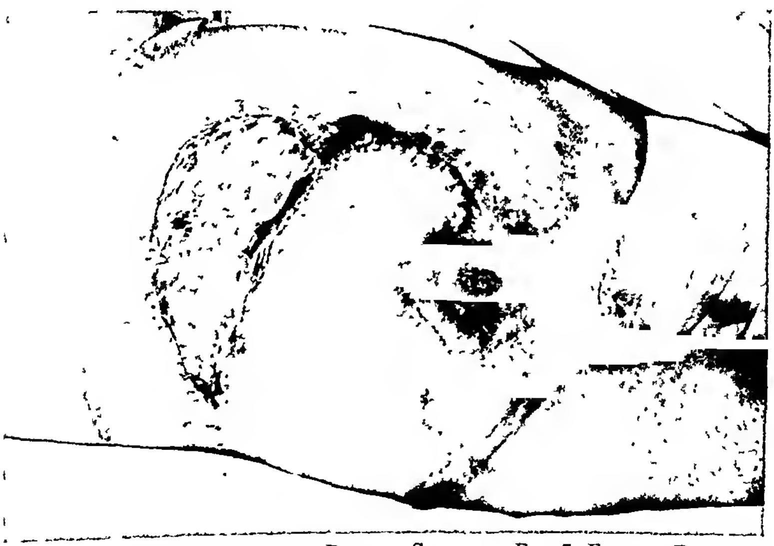

FIG. 8. PHOTOGRAPH OF THE PATIENT SHOWN IN FIG. 7, FIFTEEN DAYS POSTOPERATIVELY

There is no tension on the suture line of the flap. The split thickness skin graft roughly represents the area covered by the flap.

skin. The area from which the skin flap was removed is finally covered with a split thickness skin graft, thus eliminating tension on the flap (fig. 8). A very large and bulky pressure dressing is finally applied.

It is admitted that this phase of surgery is relatively new. Better technique and improvements of the operative procedures are anticipated. Much is yet to be learned, but even at this early date, certain methods have been found to produce unsatisfactory results with such frequency that they deserve mention if only to be avoided. Multiple small flaps, split skin grafts applied directly on the granulating area, and suturing the border skin under tension over the defects will invariably lead to failure.

In more than fifty cases which have been closed by following the above principles there were no recurrences of ulcers in the rotated skin flaps. It is believed that amputation of the bony prominences is most important in preventing recurrences. The technique of utilizing a rotary flap of skin, together with a fascia-muscle flap, and skin grafting of the donor bed so as to avoid tension on the flap, have been found promising in the surgical treatment of decubitus ulcers.

SUMMARY

Over 50 cases of decubiti in paraplegics have been closed successfully on our service. It is felt that the following details are essential in arriving at what we consider uniformly acceptable end results:

1. All patients are given large amounts of penicillin pre- and post-operatively. In addition, sulfasuxadine is used when closure of the ischial decubitus ulcers is undertaken.

2. The entire ulcer is excised, including the pyogenic membrane, well beyond the ulcer borders into healthy-appearing skin and subcutaneous tissue.

3. All underlying bony prominences are removed. We have even considered the prophylactic excision of bony prominences in cases where it appeared that the overlying skin was certain to break down, hoping that this maneuver might prevent the customary skin necrosis.

4. The bony stump, after the removal of either the ischial or trochanteric tuberosity, is covered with a flap of adjacent fascia or fascia and muscle in the ischial lesions, to prevent adherence to the overlying skin flap and aid in filling the dead space. Furthermore, the exposed cancellous bone helps to supply increased vascularity to the transposed overlying soft tissues.

5. All cutaneous defects are repaired with large rotated border flaps of skin and subcutaneous fat. No attempt is made to suture the donor area, since avoidance of tension is of prime importance. The donor area is covered with a split thickness skin graft.

6. The flap and graft are finally covered with a large and bulky dressing applied under moderate pressure.

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FIG. 11. PREOPERATIVE PHOTOGRAPH OF A TROCHANTERIC DECUBITUS ULCER. SEE FIG. 12

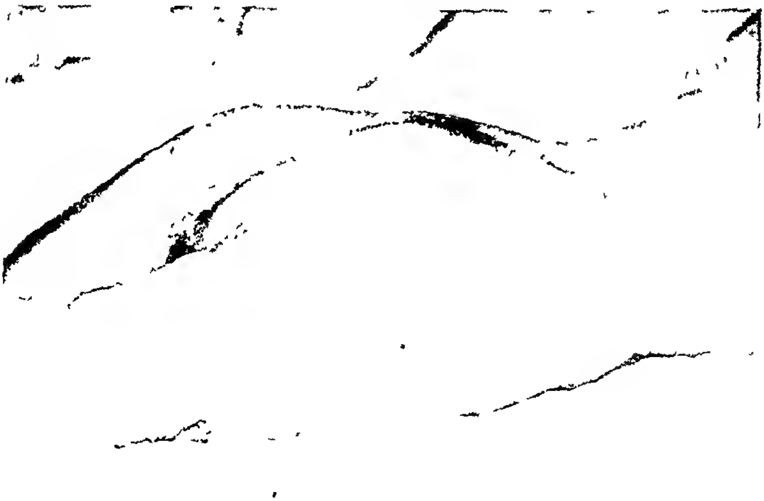

FIG. 12. POSTOPERATIVE RESULT. THE TROCHANTER WAS REMOVED AND THE STUMP COVERED WITH FASCIA LATA PRIOR TO THE ROTATION OF THE SKIN FLAP

THE FATE OF SKIN HOMOTRANSPLANTS PERFORMED ON PREVIOUSLY X-RAYED RATS*

N. RABINOVICI, M.D.

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In the study reported below we give an acount of an attempt to influence the fate of skin homografts in rats by previous irradiation of the recipient animal with a single massive x-ray dose.

MATERIALS AND METHODS

a) *Technique of Irradiation*

The x-ray apparatus (Tuto Multivolt Siemens) was operated at 160 kv. and 5 ma., with a 0.5 mm aluminium filter. The rats were placed in small boxes at about 23 cm from the target. The irradiation consisted of a single dose, and the whole of the body of each animal was irradiated.

b) *Design of Experiments*

In exploratory experiments the lethal dose of x-rays for rats was determined. It was found that after irradiation with 600 r all the animals succumbed within 3–6 days. Of those receiving 500 r an average of 55 per cent survived. This dose was therefore utilized for the irradiation of the recipient animals. Skin transplantations were made 48 hours after irradiation.

The operations were carried out under ether anesthesia and under sterile conditions. The skin to be transplanted was cut from the abdomen of the donor rat and transferred to a freshly operated wound on the abdomen of the recipient animal. The grafts were oval in form, measuring 18 mm along the major axis and 10 mm along the minor axis. The skin was excised down to the superficial fascia and the underlying fat was removed. The recipient bed was carefully prepared and hemostasis was absolute. The skin transplants were meticulously adapted to the recipient area and fixed by means of a row of 8–10 separate silk sutures. Special care was taken to ensure perfect union between the opposite skin borders. After transplantation a compressive dressing was applied.

White stock rats of about 180–250 gr. weight were used in these experiments.

The effect of X-rays on the white blood cells of the rat

The effect of a single irradiation with 500 r on the white cell count of rats is shown in fig. 1. It is seen that the irradiations are followed by a prompt and abrupt drop in the number of white blood cells. In the majority of cases gradual recovery of the white cell levels occurs. This recovery is usually slow and the pre-irradiation values are reached only after a period of 10–11 days. In some cases the fall in the number of white cells is followed by a hypercompensation over-shooting the original values and giving rise to temporary leukocytosis.

The differential count reveals (fig. 2) that the reduction of the total number of white blood cells is produced especially at the expense of the lymphocytes and that the level

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In general, the process of disintegration took the following course: For three to four days after transplantation the gross appearance of the grafts on irradiated and unirradiated rats remained unaltered. At about the third to the fourth day a marginal necrosis appeared. At this time the graft remained soft, and its colour pink. Between four and nine days the colour of the transplanted skin changed from pink to brown or brownish-grey. The graft became progressively inelastic, blisters appeared on the surface, and exfoliation of the superficial epidermal layers occurred. During the last phase the graft became black and hard and was finally eliminated.

TABLE 1.—*Time elapsed from transplantation up to complete necrosis of the graft in*

RATS IRRADIATED WITH 500 r		CONTROL RATS	
Rat No.	Number of days	Rat No.	Number of days
30	16	26	18
31	19	27	5
34	16	28	12
38	7	29	12
39	5	34	15
40	18	35	10
41	9	36	11
42	9	37	13
43	20	63	21
44	4	66	16
45	18	67	7
48	7	68	7
49	8	69	7
55	7	70	7
56	5		
57	15		
58	7		
61	23		
62	6		
Average	11.6	Average	11.5

As can be seen from Table I there was no appreciable difference between X-rayed and control animals as to the time that elapses from the moment of grafting until the point of complete necrotization. The period in which the graft breaks down varies in non-irradiated rats from 5–21 days, with an average of 11.5 days. The breakdown of the grafts in the animals irradiated with 500 r units occurs from 5–36 days with an average of 11.6 days.

The previous irradiation of the recipient animal with X-ray doses of 500 r units proved thus to be without any influence on the fate and on the duration of survival of the skin homotransplants.

DISCUSSION

It has come to be acknowledged that permanent skin transplantation between two individuals of the same species is not realizable except between monozygotic

of polynuclear leukocytes shows practically no decrease. The absolute numbers of white blood cells in general and of lymphocytes in particular are at their lowest 48-72 hours after irradiation. Our observations on the effect of X-rays on the white blood cells of the rat are in accord with the results obtained by the majority of authors working in this field(7).

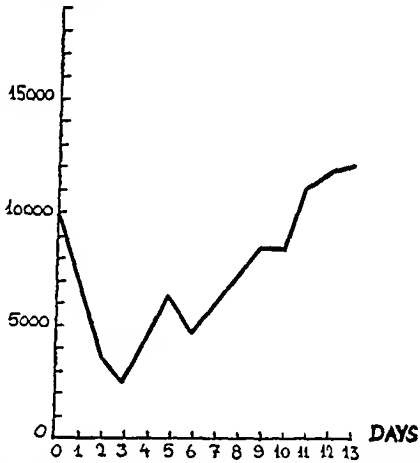

FIG. 1. THE EFFECT OF A SINGLE IRRADIATION WITH 500 r ON THE WHITE CELL COUNTS OF RATS

Composed curve formed by averaging the counts for 37 animals.

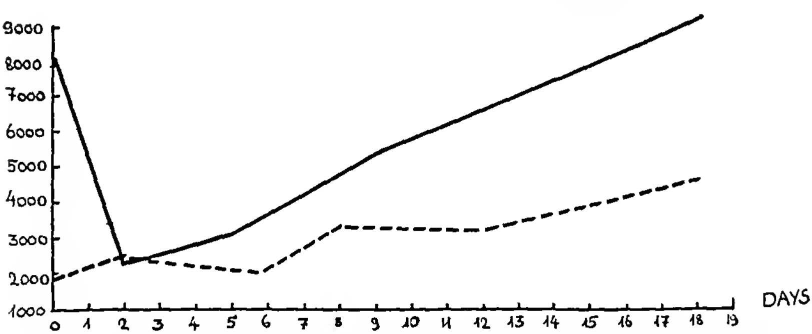

FIG. 2. THE EFFECT OF X-RAY TREATMENT ON THE CIRCULATING LYMPHOCYTES AND POLYMORPHONUCLEAR LEUKOCYTES OF RATS

Solid line—actual number of lymphocytes.
Dotted line—actual number of polynuclear leukocytes.
Composed curves formed by averaging the counts for 37 animals.

FINDINGS

In no case did we succeed in permanently transferring skin homografts to X-rayed rats. Complete breakdown and destruction of the transplanted skin took place at the latest 19 days after the operation.

There was no consistent difference between the control and experimental animals in the evolution of the process of destruction of the foreign skin grafts.

In general, the process of disintegration took the following course: For three to four days after transplantation the gross appearance of the grafts on irradiated and unirradiated rats remained unaltered. At about the third to the fourth day a marginal necrosis appeared. At this time the graft remained soft, and its colour pink. Between four and nine days the colour of the transplanted skin changed from pink to brown or brownish-grey. The graft became progressively inelastic, blisters appeared on the surface, and exfoliation of the superficial epidermal layers occurred. During the last phase the graft became black and hard and was finally eliminated.

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DISCUSSION

It has come to be acknowledged that permanent skin transplantation between two individuals of the same species is not realizable except between monozygotic

twins (29, 16, 20, 24). After a period of primary union the transplanted foreign skin is invariably destroyed and eliminated, generally within a relatively short time. The necrosis of the graft is preceded by a massive invasion of the graft by round cells and intense vascular proliferation originating from the graft bed (25). The essential reason for the unfeasibility of homotransplantation probably lies in the fact, that the chemical characteristics of all or almost all the tissues of the individuals within a certain species are not identical. This difference, which Loeb (18) designated as "organismal differentials" determines the reaction between the donor and the host resulting in the breakdown of the graft. The nature of this reaction is a subject of much controversy. It is highly probable that the essential mechanism by which foreign skin is eliminated belongs to the general category of "actively acquired immune reactions" (Gibson and Medawar (9)).

Several attempts have been made to overcome the incompatibility which renders the homotransplantation impossible. The results of these attempts are conflicting. In order to lower the resistance of the host to homotransplants Lehmann and Tammann (15) blocked the reticulo-endothelial system by the injection of trypan blue. Homotransplantation was performed 14 days after the injection of the dye. The authors claim that a number of animals showed ideal "takes," whereas in the controls not a single graft had taken. In contrast, Golanitzky (10) treating animals with carmin or trypan blue, never achieved successful skin homotransplants.

Rhode (28) attempted to lower the resistance of the recipient animal toward skin homotransplants through previous treatment with blood plasma, serum, skin extracts and skin autolysates. This treatment had no effect on the fate of the homograft, which usually failed to survive on the desensibilised animals longer than in the controls. Splenectomy performed previously to skin transplantation also had no favorable effect on the "takes" of the skin homografts. On the other hand, Baetzner and Beck (1) claimed to have obtained a longer period of survival of transplanted foreign skin in desensitised animals.

Since the problem whether it is possible to alter the resistance of animals to skin homotransplants can be regarded as still unsettled, we have decided to take it up anew. In order to lower the resistance of the host towards the skin homotransplants we used the method of irradiation with X-rays.

It is known that in X-rays we have at our disposal an effective means to lower the resistance of the organism towards antigens. Benjamin and Sluka (2) found in animals irradiated before injection of beef serum the precepitin titer was lower and the antigen disappeared more slowly than in normal animals. Hektoen (12, 13) showed that production of lysin for red blood corpuscles was markedly reduced in animals which received large doses of x-rays at the start of immunization. The fact that X-rayed animals have increased susceptibility to experimental infection was shown by Zinsser and Castaneda (31), and Liu, Snyder and Enders (17) for typhus rickettsiae, by Naiman (26) for *Trypanosoma lewisi*, by Taliaferro, Taliaferro and Simmons (30) for *Plasmodium gallinaceum* and *Plasmodium lophurae*, by Gowen and Zelle (11) for mouse typhoid and by DeGara and Furth (6) for pneumotropic viruses.

In numerous experiments it has also been demonstrated that previous x-irradiation lowers the resistance of animals to transplanted tumors (Murphy and Morton (23), Chambers, Scott and Russ (4), Zweig (32)), as well as to leukosis (Krebs, Rask, Nielsen and Wagner (14), Furth, Seibold and Rathbone (8)), and also permits the survival of tumor-heteroplants beyond the normal time period (Murphy (21, 22), Bullok and Rohdenburg (3), Nordholt (27), Clemmensen (5)).

Contrary to our expectations, our experiments proved completely negative. Grafts of foreign skin on irradiated animals behaved exactly as did those on non-irradiated controls. Just as in untreated animals skin transplants on irradiated rats became necrotic and were sloughed off. The periods elapsing between the operation and the breakdown of the transplants are identical in experimental and control animals. The resistance displayed by the animal to skin homotransplants is not only not overcome by X-rays, but is not even weakened by them.

In connection with the view put forward by Loeb (19) as to the essential rôle of lymphocytes in the mechanism of the elimination of grafts of foreign tissues it is noteworthy that in our experiments the elimination of the skin graft in irradiated animals took place after a normal period despite the fact that the lymphocyte count in the circulating blood falls sharply and remains low for a considerable time in recipient animals as a result of irradiation.

SUMMARY

An attempt to influence the fate of skin homografts in rats by previous irradiation of the recipient animal with a single dose of 500 r units is reported. The necrosis of the transplanted foreign skin occurred on irradiated rats and control animals after the same time period. No difference in the evolution of the process of disintegration between control and experimental animals was observed. The elimination of the transplanted skin occurred in irradiated animals in spite of the fact that the number of lymphocytes in the peripheric blood was considerably reduced for a prolonged time after the irradiation.

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REPORT OF CLINICAL EXPERIENCES WITH HOMOGRAFTS

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INTRODUCTION

As the popularity of free skin grafting spread throughout the surgical world in the latter part of the nineteenth century, it was apparently generally accepted that skin from one person could be grafted on another with almost the same assurance of success as when the patient's own skin was used. The literature of this period and of the early nineteen hundreds contains numerous reports of successful homografts.

From about 1910 on, published reports indicate, with very few exceptions, that homografting in human beings has not been permanently successful, and for other than a temporary covering in certain cases of extensive burns, the grafting of skin from one person to another has been abandoned. For a time following the introduction of the principles of blood grouping for transfusions it was thought that these same factors might govern the successful transplantation of skin from one person to another (1). Subsequent investigations, however have indicated that homografts repeatedly fail in spite of the compatibility of the known blood groups for donor and recipient (2). The only clearly authentic cases of permanent successful homografts have been in monozygotic twins (3, 4).

With general acceptance of the fact that random homografts will not survive, attention has been directed to investigating the mechanism whereby foreign skin is destroyed and to possible methods of preventing this destruction.

INVESTIGATION OF SKIN GROUPS

The evidence obtained by Gibson and Medawar (5) and by Medawar (6) in numerous carefully controlled experiments in rabbits leaves little doubt that in this animal the mechanism of destruction is based upon the presence of an active immunity which develops in the host as a result of the antigen action of the foreign tissues of the homograft. The behavior of homografts in the rabbit corresponds closely to that of homografts in man, and it is highly probable that the mechanism of destruction is the same in the two species. Holman's (7) observations on homografts in man particularly substantiate this view.

If this concept is correct, two general methods of approach to the problem are available as suggested by Medawar (8): (a) to alter the tissues of the graft in such a way that they are no longer antigenic to the host, a method previously investigated by Stone and his associates (9) in the case of certain endocrine glands, or to alter the immunological mechanism of the host to accept the foreign tissues of the graft; (b) to attempt to find a donor whose unaltered tissues are compatible with those of the recipient and do not act as an antigen. This latter

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approach we have attempted to explore by simultaneously transferring skin from seventy-one different donors to a single recipient. Although all grafts "took" none were permanent.

CLINICAL OBSERVATIONS

N. B., a four year old colored female, had received extensive third degree burns over the back and thighs several weeks before these observations were made. About one half of the burned area had been covered with autogenous split thickness grafts. The upper half of the burned area of the back was covered with clean firm granulation tissue, and it was to

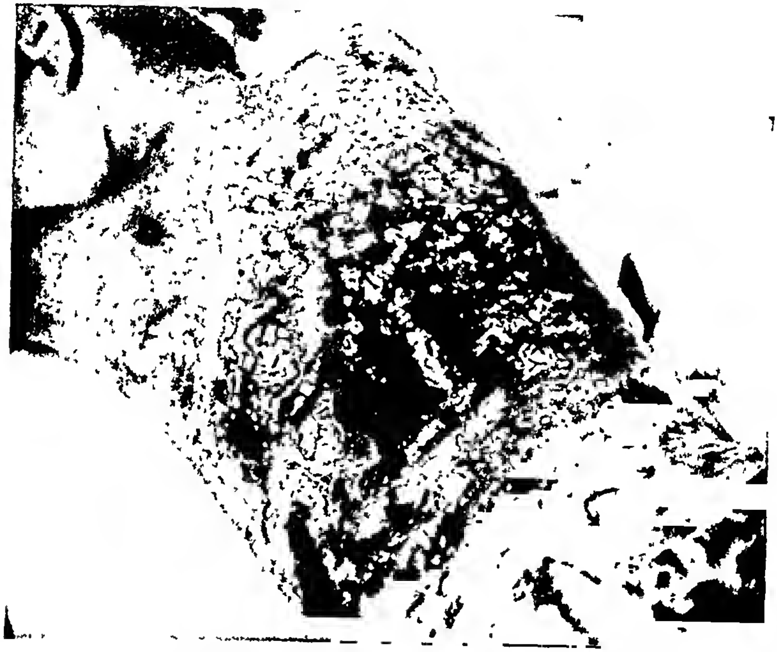

FIG. 1. GRANULATING AREA ON PATIENT'S BACK WITH PINCH HOMOGRAFTS FROM SEVENTY-ONE DIFFERENT DONORS, FOUR DAYS AFTER GRAFTING

(Pigmented grafts from negro donors are not clearly seen.)

this area that the homografts were applied On May 10, 1946, seventy-one unrelated volunteer donors were selected without regard to race or blood group. Under local anesthesia a single small deep graft was removed from the thigh of each donor and within two hours all of the grafts were applied to the selected recipient site on the child's back (fig. 1). The average diameter of the grafts was 6 mm. The grafts were carefully applied in a definite pattern so that each graft could be identified. By the fourth day all of the grafts appeared to have taken. At this time one graft was pulled off during the changing of the dressing. This was the only graft in the series which was known to have been lost by technical error. During the first week the grafts were dressed with a vaseline pressure dressing. Thereafter moist compresses were applied and the area was inspected daily.

Some difficulty was encountered in evaluating the progress of the grafts during the early observation due to changing conditions of the surrounding granulation tissue. For in-

stance, on May 27 seven grafts were listed as gone. Four days later it was discovered that four of these grafts were in place and were viable but that they had been overgrown by exuberant granulation tissue. All of the observations are based upon the gross appearance of the grafts; no microscopic studies were made.

From the nineteenth to the twenty-fourth day after grafting the most marked outgrowth of epithelium occurred (Chart 1). On the twenty-third day spreading epithelium was noted about the periphery of thirty-two grafts. From the twenty-fourth to the thirtieth day after grafting the spreading epithelium rapidly disappeared so that by the end of this period regenerated epithelium was noted about only three grafts; and as these grafts were in areas

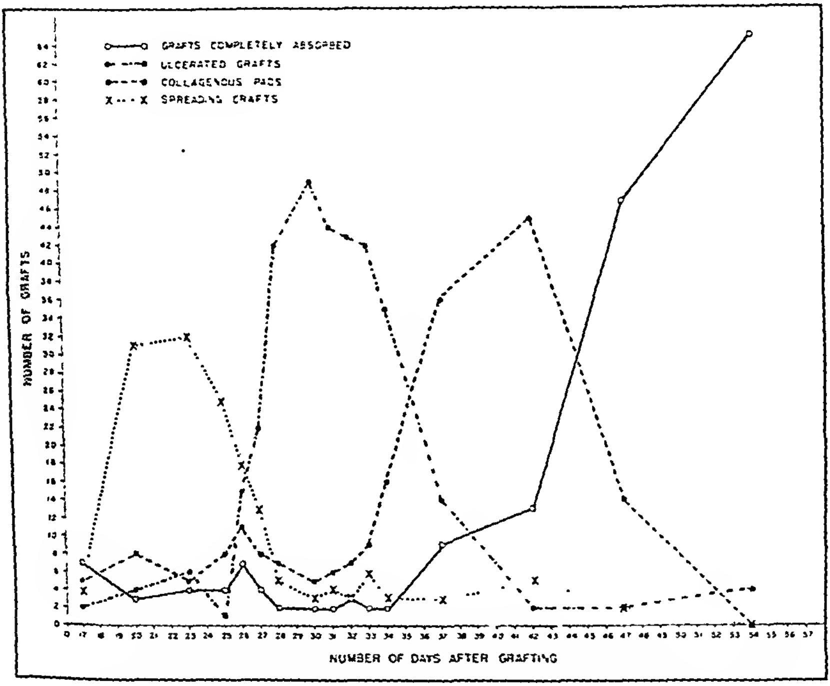

Chart I. Summary of Gross Conditions of Grafts during Fifty-four Day Observation Period

contiguous to the border of the patient's own skin, it is highly probable that they were merely serving as a "bridge" for autogenous epithelium. During this same period ulceration of the epithelium covering the grafts themselves increased, reaching a maximum on the thirtieth day when fourty-nine grafts were described as ulcerated. Following the ulceration a pad of collagenous tissue remained and usually could be identified for a period of about two weeks. The number of these collagenous pads reached a maximum on the forty-second day. At the time of the final observation (fifty-fourth day) two such collagenous pads were all that remained of any of the grafts.

After five and a half weeks there remained a single graft that had retained its original size and was still covered with firm epithelium although there was no spreading epithelium. The donor of this graft was traced and a split thickness graft 6 cm. by 4 cm. removed from

his thigh and placed upon a previously ungrafted area of the patient's back. There was a primary "take" of almost the entire graft (fig. 2); however, nine days later the superficial epithelium began to ulcerate and by the fifteenth day only a faint outline of collagenous fibers remained of the graft. Strangely enough, it was not until this second graft was almost completely gone that the epithelium of the original small deep graft began to show evidence of ulceration.[1]

DISCUSSION

Medawar (10) has investigated the possible number of skin antigens and skin transplantation groups in the rabbit. Pinch grafts were removed from each of twenty-two unrelated rabbits and transplanted to all of the other animals, each

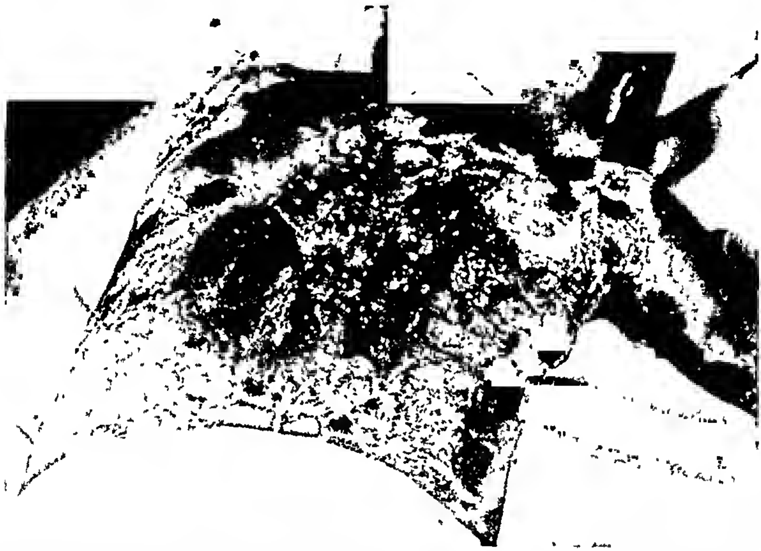

FIG. 2. PHOTOGRAPH OF PATIENT'S BACK SIX AND ONE HALF WEEKS AFTER ORIGINAL HOMOGRAFTING AND SIX DAYS AFTER GRAFTING OF SPLIT THICKNESS GRAFT FROM ONE OF ORIGINAL DONORS

animal thus serving as a donor and as a recipient to all of the other rabbits. In all cases there was an initial take of the grafts; although there was a considerable variation in the survival time of such grafts, none were permanently successful. From these results Medawar has concluded that there are *at least* seven independently combined antigens governing the grafting reactions of the skin of rabbits with the corollary that a rabbit may belong to one of *at least* one hundred and twenty-seven skin transplantation groups.

The results of our experiment were submitted to Dr. Margaret Merell[2], for

[1] This observation was readily made by gross examination as the donor was a negro and ulceration of the superficial epithelium removes the pigmented covering of the graft.

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analysis in regard to any conclusions which might be drawn as to the possible number of skin groups in human beings. Her report follows.

"Assume that a population indefinitely great in number is composed of k different groups of equal size, each group characterized by a specific antigen or group of antigens such that it is possible to perform successful skin grafting from one individual to another, only if they are members of the same group.

"Then the probability that one individual chosen at random is a member of a particular group is $\frac{1}{k}$. If n other individuals are chosen at random, the probability that none will be successful skin donors to the first is

$$P = \left(1 - \frac{1}{k}\right)^n$$

"If n donors have been tested against a recipient and the results have been completely unsuccessful, it is possible to compute P for varying assumed values of k and thus to determine the smallest number of groups likely to yield this result.

"If we say that any k which would yield this result five times or more in one hundred tests is a possible k, but any k which would yield this result less often is an unlikely k, we can, by setting P = .05 solve for the border-line k. Any k larger than this is more likely to give this negative result, any k smaller than this is too small to make a completely negative result likely.

"In the observed series where seventy donors failed to produce successful grafts for one recipient, we would have

$$P = \left(1 - \frac{1}{k}\right)^{70}$$

Setting P = .05 and solving for k gives k = 23. Thus we can say that it is unlikely that there are *less than* twenty-three groups.

"If the groups are assumed to be unequal in size, it can be shown that a still larger number of groups would be necessary to give a P of .05. Therefore the solution given for equal groups yields the minimum number of groups that it is reasonable to postulate from the evidence at hand."

Blood groups in homografting

Padgett (4) reports a series of fourty-four homo transplants of skin, many of which were between members of the same family. None of the grafts were permanently successful nor did the relationship of donor and recipient seem to influence the take or the survival time of the graft. Skin grafts were transplanted from one identical twin to the other and vice versa. These grafts were viable over a year later. He checked the blood groups of these patients and made the following report: "A faint suggestion is given that immediate takes are more probable if the cells (blood) of the donor are not agglutinated by the *serum* of the recipient."

Brown and McDowell (2) have reported a patient who received skin grafts

from twenty-six donors whose blood groups were determined. None of the grafts survived permanently. No relationship was found between the blood groups of donor and recipient and the initial take or length of persistence of the grafts. Similarly in our study no correlation could be made between the behavior of the graft and the blood group of the donor. The recipient in the present study belonged to blood group B. Of the skin donors whose blood was typed seven were group A, two were group B, and nine were group O.

FIG. 3. PINCH HOMOGRAFT WELL HEALED TWO MONTHS AFTER TRANSPLANTATION TO RECIPIENT AREA COMPLETELY SURROUNDED BY NORMAL SKIN

Microscopic sections of this graft indicate it has probably been replaced by tissues of the recipient.

The use of pinch grafts in the study of homografts

In 1939 Binhold (11) reported successful homografts in fifty-one of one hundred and sixty-seven transplantations after an interval of three to seven months. These grafts were small deep grafts or pinch grafts which were fitted into a small defect in the recipient's normal skin. Such grafts could, of course, have been readily overgrown by the recipient's own epithelium. In one of our patients we have biopsied a similar type of homograft that grossly appeared to be a permanent survival two months after transplantation (fig. 3). The graft was covered with a regenerated type of epithelium without rete pegs. Hair follicles and sweat glands were entirely absent. The normal architecture of the derma was destroyed and replaced with scar tissue containing dense accumulations of round cells. Special stains demonstrated fragmentation of the few elastic fibers which remained in the grafted area. Although it cannot be categorically stated, it seems reasonable

to assume from these findings that the original tissues of the graft had died and had been replaced by invading tissues from the host.

Mandl and Rabinovici (12) have reported a case in which pinch homografts survived on a granulating area for fifty days. Grossly the grafts survived in much the same manner as pinch autografts which were transplanted at the same time. However, the homografts did not develop spreading epithelium. Microscopic studies of these grafts were made after forty-three and fifty days, and although they demonstrated the grafts to be viable at this time, it is unfortunate that apparently all of the grafts were removed for microscopic study and thus it is uncertain whether the grafts might have survived "permanently" or not. The pinch graft from one donor in our series of seventy-one different homografts showed no gross evidence of absorption until the fifty-first day after transplantation.

Infant foreskin as homografts

Ashley (13) in 1937 reported the successful use of infant foreskins as homografts in two cases. In the first case nineteen out of a total of twenty-seven foreskin homografts were reported as successful, and the patient's foot, which had been almost completely denuded of skin, was apparently satisfactorily re-epithelialized. Two of four grafts in the second case took. He states, "They grew well, fused with one another and with the edge of the denuded areas." The grafted area of both cases was apparently satisfactorily healed six months later at the time of his report.

As embryonic tissue has been successfully homotransplanted in species other than man (14, 15, 16), we felt that this observation warranted further investigation and have applied a series of twenty-four foreskins from newborn infants as homografts. Immediately following excision the foreskins were placed in a sterile container wrapped in gauze which had been moistened with saline. Most of the grafts were applied within four hours from the time they were taken. Three grafts were stored for as long as twenty-four hours before being used. Twenty-four grafts were applied to eight different areas on a total of five patients. The grafts were washed with aqueous zephiran, carefully spread out over a clean granulating recipient area, and dressed with pressure dressings. Of the twenty-four grafts, nineteen were necrotic when first dressed on the fifth day and showed no evidence of having taken. The remaining five grafts showed evidence of a complete or partial "take" at the time of first inspection as they were firmly attached, and the color indicated an adequate circulation. None of them, however, survived beyond the fourteenth day. We have, therefore, been unable to confirm Ashley's report of the successful use of infant foreskin as permanent homografts.

SUMMARY

(1) In attempting to explore the possibility of the existence of skin transplantation groups in man, homografts were transferred simultaneously from seventy-one unrelated donors to a single recipient. Although all grafts originally "took," none survived permanently.

(2) It has been determined from these results that if such skin transplantation groups do exist, it is unlikely that they are *less than* twenty-three in number.

(3) Additional evidence has been obtained to indicate that the blood group of recipient and donor do not influence skin homografting.

(4) Histological studies of a homograft transplanted as a pinch graft into a bed surrounded by normal skin suggest that what appears to be a permanent survival of the homograft is actually an overgrowth of the area by the tissue of the host.

(5) Of twenty-four newborn infant foreskins used as homografts an initial "take" was obtained in five instances. None of these grafts survived permanently.

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SURGICAL REMOVAL OF TRAUMATIC TATTOOS OF THE FACE*

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Traumatic tattoos of the face are deposits of pigmented foreign bodies, usually dirt and detritus, which have been forced into the tissues by a variety of mechanical means, and can involve any or all layers of the skin and subcutaneous tissues.

Once imbedded, their removal becomes a problem of recognized importance, which could be solved in a relatively simple manner at the time of injury. More courage, and a little extra time on the part of the attendant who cares for the initial wound would eliminate the disfigurement and prevent the necessity of subsequent surgical repair.

Since the patient's condition following injury is sometimes unfavorable for surgery, these wounds are frequently neglected. However, with novacaine infiltration or block, the procedure is not shocking, and the few extra minutes required for the thorough cleansing and debridement of the wound frequently is more than compensated by the elimination of a facial disfigurement which is a source of curiosity and considerable embarrassment to the patient.

The accepted initial care, as is well known, is conscientious scrubbing with a moderately stiff brush and copious irrigations with warm normal saline, followed by ether, and dressing with vaseline gauze.

However, once the wound has been allowed to heal, and the surface epithelium has formed, the foreign bodies are trapped in the tissues and nothing less than surgical removal will eliminate the disfigurement. It is true that a small percentage of the material may, over a period of time, find its way to the surface and be extruded, but the amount is usually insufficient to make much change in the extent or depth of color of the deposit.

The procedure to be described for the removal of the healed tattoo is one which seems to have promise in those cases involving mainly the dermal layers. In cases in which both the skin and subcutaneous tissues are involved, it has proven likewise beneficial by uncovering the deeper deposits, which can frequently then be removed by simple excision.

Although the procedure appears to violate, by its seemingly brutal treatment of tissues, some of the fundamentals of surgical technique, the final results in our hands have been more encouraging than any previously devised methods.

Other procedures used for the correction of extensive tattoos are (1) Total excision and replacement with free skin grafts. The primary objections to this method are secondary contracture and pigmentation of the graft. In some free grafts, on the other hand, there develops a deficiency of pigment, and the dead white appearance causes as striking a contrast to the surrounding skin as the

* Read before the Philadelphia Academy of Surgery, January 6, 1947.

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graft which has become hyperpigmented. (2) Some cases have been treated by excision and replacement with pedicle flaps from other parts of the body. Here the same objections arise; namely, abnormal pigmentation. And, although the secondary contracture is not of such importance, there is the added disadvantage of excessive deposits of fat in the subcutaneous tissue which add bulk to the repaired area.

In our experience, the highest percentage of foreign materials has been found in the dermal layer. In consequence, removal by an abrasive such as ordinary sandpaper, combined with the coagulating action of tannic acid and silver nitrate, has resulted in an improvement without complete destruction of the normal skin-

A B

CASE I

A. M. (fig. a) Victim of land-mine explosion, Saarbruecken, Germany, January, 1945. (fig. b) After abrasion treatment in two stages Stage 1—forehead and right half of face, Stage 2—chin and left half of face

regenerating organs. If the process stops short of the full-thickness of the skin, the epithelial linings of the sebaceous glands and hair follicles will regenerate a normal epithelial covering in approximately 10 to 14 days.

The epithelium exhibits the characteristic erythema of any new skin such as that which generates following a brush burn, or the removal of a split-thickness graft. This high color, however, fades with time, and by 8 to 10 weeks, it blends indiscernably into that of the normal surrounding skin.

The procedure was originally devised for the removal of tattoos resulting from land mine explosions during the most recent war, but has subsequently been utilized to remove the deposits resulting from civilian wounds such as brush burns, and dirty lacerations. It has not been attempted on the ordinary commercial tattoo because of the depth at which the pigments are deposited.

Details of the technique used, and the preparation of the materials are as follows. Ordinary carpenter's sandpaper, grit 0 and 00, from almost any hardware store, is cut into dimensions equal to the width and circumference respectively of a three-inch gauze bandage. A strip of adhesive tape one inch wide and three inches long is cut and one half its width is applied to the edge (width) of the smooth surface of the sandpaper. The latter is then wrapped around the gauze roll, and the last half inch is pressed against the remaining half inch of the adhesive surface of the tape, thereby forming a complete sandpaper covering over the gauze roll. This provides a curved surface which is capable of fitting down into depressions and over elevations on the face. Smaller pieces can be cut to

A B

CASE II

T. M. (a) Injured by booby-trap explosion resulting in loss of left eye and traumatic tattoo of left half of face.
(b) Five weeks following abrasion with sandpaper.

wrap around a Freer perichondrial elevator at the time of operation to more effectively reach crevices such as the naso-labial fold. These strips and the sand-paper-covered gauze rolls are then wrapped in towels and autoclaved.

The skin of the entire face is prepared surgically with green soap, alcohol, ether, and any of the standard skin antiseptics, such as tincture of merthiolate.

Local infiltration is preferable to general inhalation anesthesia because of (1) its hemostatic properties, (2) the ability of the patient to cooperate during the procedure, and (3) less likelihood of post-operative nausea and vomiting with resulting contamination of the abraded surfaces.

One percent novocain with adremalin (5 to 10 drops per ounce) will provide adequate anesthesia, and the lower strength has the advantage of allowing larger amounts to be used. Since relatively extensive surfaces are frequently involved,

the problem of overdosage is not so serious as it would be if more concentrated solutions were used.

After the surface is surgically prepared and infiltrated, it is abraded vigorously with the sand-paper roll. Capillary oozing will be profuse, but subsides spontaneously in a surprisingly short time. Hot saline packs, and adrenalin will decrease the coagulating time further. There will be a natural tendency at first to be timorous about carrying the procedure too deep. But it should be kept in mind that the dermal layers are composed of a very compact arrangement of elastic fibers and other connective tissue elements, and so are capable of tolerating an inordinate amount of abrasion, and their regenerating powers are exceedingly active. We have found it safe to carry the procedure if necessary to the point

A

B

CASE III

J. D. (a) Injured January, 1947, in iron foundry by impregnation of oil and dirt by high compression hose.
(b) Six weeks post-operative Few remaining flecks in subcutaneous tissue have since been removed by simple excision

where subcutaneous tissue gradually makes its first appearance in pin-point elevations of fat through the abraded corium. Large areas of subcutaneous tissue will not appear suddenly. In only two instances have we taken the procedure to the point where, after healing, there was evidence of scar. These scars were not extensive, and were easily corrected by simple excision and primary closure. One scar, although not more than 1.5 cm long appeared definitely hypertrophic. This possibility should constantly be kept in mind.

Since a definite tendency exists for particles of sand to become detached from the paper, they may, if left in the tissues, become buried under the new epithelium and form small granulomata. This, however, can be readily obviated by copious irrigations of warm normal saline. Adrenalin added to the saline will at the same time aid in hemostasis.

The freshly abraded and washed surfaces are then made as dry as possible by

A B

CASE IV

A. D. (a) Land-mine explosion victim which resulted in deposits in both skin and subcutaneous tissue.
(b) After combined abrasion and excision.

A B

CASE V

J. O. (a) "Brush-burn" resulting when patient was thrown from a horse.
(b) Result from combined abrasion and excision.

gentle pressure with gauze. A protective eschar of 10% tannic acid, followed by 10% silver nitrate is formed by three or four successive applications with ordinary cotton sponges.

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PRE-OPERATIVELY APPLIED, MATED, PLASTER OF PARIS CASTS AS AN AID IN THE MIGRATION OF OPEN-PEDICLE CROSS LEG FLAPS

RICHARD B. STARK, M.D.*

The number of lower extremity wounds involving loss of full-thickness skin and subcutaneous tissue incurred during this war has been large. These wounds have healed through the formation of cicatricial tissue, or they have been hastened in this healing through the application of split-thickness skin grafts. If they cover bone, many of these healed wounds will break down, and often there is further underlying damage which necessitates the repair of bone, tendons, or nerves. To effect this repair through scar tissue or a split-thickness skin graft is hazardous; it is often necessary in these cases to replace the coverings of these wounds with full-thickness skin and subcutaneous tissue. The most expedient and satisfactory method of covering foot and leg wounds of the type mentioned without depriving the same extremity of similar covering is the open-pedicle cross-leg flap.

Apart from minor variations, this operative procedure has become moderately well standardized in most reconstruction hospitals. After several delays of the proposed flap to effect hypertrophy and hyperplasia of the re-oriented blood vessels, the flap is migrated from one leg or thigh to the recipient leg. *After* this migration, the legs are immobilized in a cross-leg plaster-of-paris cast for three to four weeks before the flap is severed. Of these procedures, the migration of the flap from the donor to the recipient leg is technically the most difficult. It is the purpose of this paper to propose a variation of this procedure in the use of pre-operatively applied, mated, plaster-of-paris casts to facilitate and expedite this operation.

The advantages accrued from the pre-operative application of the plaster-of-Paris casts are several:

1. The casts can be carefully applied the preceding day with adequate padding about the knee, common peroneal nerve, tibia, both malleoli, and heel. As the patient must remain in his cast for from three to four weeks, it is essential that he be comfortable and that he not develop pressure ulcers from his immobilization device. Correctly padded casts are difficult to apply after the pedicle flap has been migrated into place.

2. The operator's time is reduced, for to apply what virtually amounts to a spica cast and to apply it well and carefully with the pedicle flap attached to the opposite extremity increases one's time in the operating or cast room appreciably. In a procedure where position is of utmost importance, it is a rare operator who would leave the casting or even the maintenance of position to another. If pre-operative casts have been applied, the only additional time required, if any,

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To afford as dry a surface as possible, a sterile dessicant, such as talcum or sulfadiazine powder is dusted over the eschar, and the area covered with sterile fine meshed gauze. Over this is placed a pressure dressing of gauze or mechanic's waste, which is allowed to remain for about 72 hours.

For many years considerable controversy has existed concerning the treatment of denuded areas from second and third degree burns by tannic acid and silver nitrate. In brief, some of the more prominent objections have been, (1) toxic absorption and liver damage, (2) infection, and (3) local chemical destruction of the tissues, specifically coagulation necrosis of the cells with which the agents come in contact. Even during the period when it enjoyed its greatest popularity, these measures were considered contraindicated on the hands and face. On the hands, the main objection was the constricting effect of the inflexible bands around the fingers which at times jeopardized circulation when the inevitable edema appeared. This objection was from all standpoints justifiable. Eschars on the face were considered objectionable mainly because of the difficulty in prevention of infection from constant exposure to contamination from the air, saliva, and nasal secretions.

In spite of the apparent hazards of using these agents on the face in burns, we feel we have used them to advantage in the abrasive treatment of traumatic tattoos. In fact, one of its predominant liabilities—the destructive action to cells, has, in this instance, proven to be one of its chief assets. By its coagulating action, it not only produces a protective covering, but in addition, carries the destruction deeper than the abrasion, and thereby removes more deposition of pigment by incorporating it into the eschar. When the latter separates, more of the pigment will have been removed than if the denuded surface had been dressed with vasaline gauze or xeroform.

To minimize the development of infection, the eschar-covered surface is not left exposed, but is treated as a fresh surgical wound for three days and chemotherapy is instituted prophylactically over the same period. If these precautions are observed, a clean dry eschar-covered wound will become epithelialized within two weeks at the end of which time the major portion of the eschar will have separated, leaving a smooth pink skin. No appreciable permanent difference in color between the new and the adjacent old skin has been noted.

Unfortunately conditions prevailing in the practice of army medicine makes a satisfactory follow-up on such cases prohibitive, so that any late changes would not necessarily have been called to our attention. However, in a few isolated instances, letters from those who have been subjected to the treatment indicate that there have been no untoward developments to date.

area through these convenient windows is greatly enhanced. Through them the dressings may be changed, sutures removed, and the pedicle flap and split-thickness graft easily visualized.

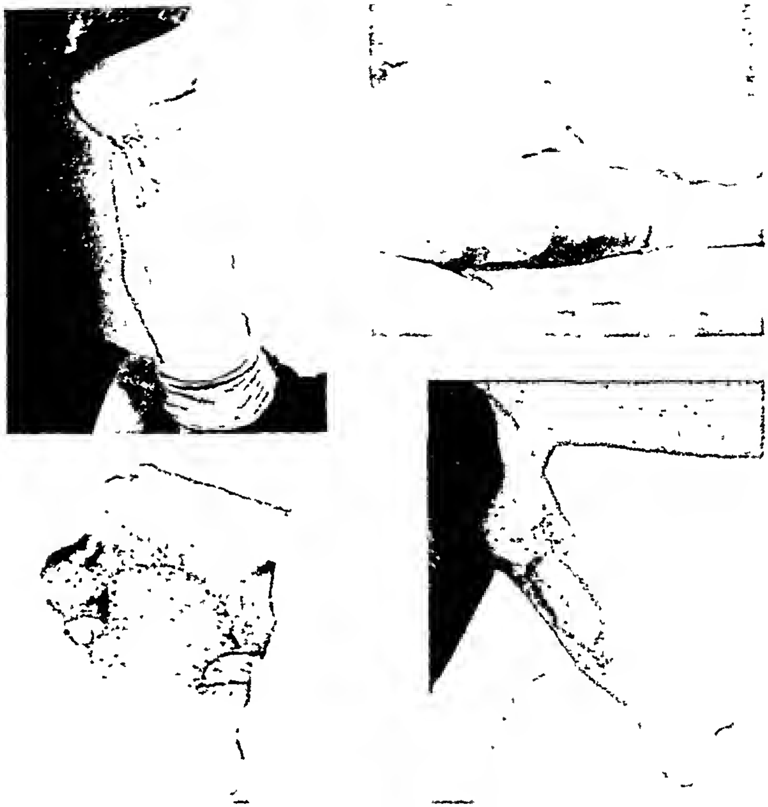

FIG. 2

(Upper left) Avulsed wound of left calf involving muscles of the triceps surae group, partially healed through scar tissue formation which was adherent to underlying flexors of the foot. (Upper right) Pre-operatively applied plaster-of-Paris casts with distal extremities assuming post-operative positions. (Lower left) Right medial calf flap migrated to left medial calf. Two casts incorporated into one unit through the addition of circular plaster-of-Paris at the points of juncture between the casts. (Lower right) Open-pedicle flap severed and final margin sutured into place. This flap healed the open wound and was not adherent to the underlying muscles.

5. With the pre-operative incorporation of the metallic holding devices into each cast, to which reference is made later, the casts may be secured in their proper post-operative positions, so that, with the completion of the operation, a sterile dressing may be applied. If the legs must be casted post-operatively, the flap should be in full view to best apply this cast and to maintain optimum

before the patient may be sent to the recovery ward is in the final maintenance of the relative positions of the two casts so that the pedicle may be immobilized in the optimum position. Reference is made to this later in the article.

3. Trauma to the pedicle flap is lessened when pre-operative casts have been applied, for the application of circular plaster-of-Paris to the two legs joined by

Fig. 1.

(Upper left) Left foot and leg, loss of tibial substance with healing by scar tissue formation Skin circulation of distal leg poor (Upper right) Pre operatively applied plaster of-Paris casts with distal extremities assuming post-operative positions Inset vertical metal pieces visible Patient had previous amputation of right foot (Lower left) Distally based right anterior thigh flap migrated to left medial distal leg Two casts incorporated into one immobilization device by means of the long perforated metal bar (Lower right) Open-pedicle flap severed and final margin sutured into place The flap has improved the circulation of the distal leg A bone graft to the left tibia remains to be done

Photos by Signal Corps, U S Army

the pedicle flap results in great or slight alterations in the position of the pedicle while the casts are being applied. Any such alterations reduce the gentleness necessary in the handling of all tissues.

4. Because the migration operation of the open pedicle flap is done through windows cut into the casts, the subsequent care of the flap and the grafted donor

PROCEDURE

An exact oil-silk pattern of the cautiously planned and previously delayed pedicle flap is first made adherent to the base of the pedicle with collodion, and the legs are made to assume their planned positions. The oil-silk pattern then should rest easily upon the contralateral defect to be grafted. With the base of the pattern secured to the base of the pedicle flap and with the free end covering the defect of the opposite leg, the lower extremities are then assuming their post-operative positions. When it has been explained to the patient that he must not move his angle of knee and ankle flexion, the donor leg is led away from the other and a long-leg plaster-of-Paris cast is applied. A window is cut out to free the oil-silk pattern, and the post-operative positions of the two legs are again assumed. The uncasted leg is likewise led away and casted. A like window then is cut out above the defect.

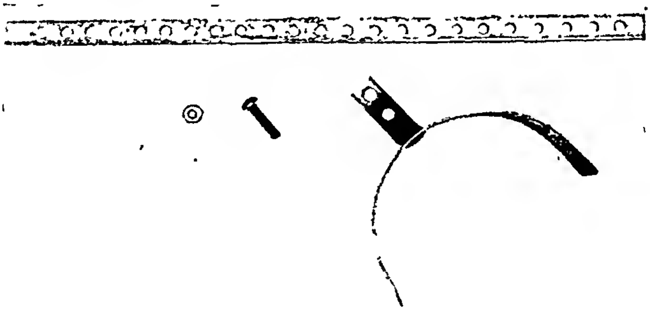

FIG. 4
Semi-circular metal band with attached perforated vertical metal piece. Casts are bolted together by means of the long perforated metal bar.
Photo by Signal Corps, U. S. Army

Now that the two casts have been applied in a mated fashion, the problem of incorporating the separate casts into one immobilization device may be handled in one of several ways.

Pre-operatively, this may expeditiously be done by incorporating into each pre-operative cast two or four semi-circular metal bands with a short vertical metal piece attached containing a single perforation. The two casts are then incorporated into a single unit through the addition of a long perforated metal bar which is bolted to the short vertical metal pieces inset into each cast. This method will immobilize the casted legs in the desired position prior to migration of the pedicle flap, thereby saving much arduous extremity holding upon the parts of the assistants.

Post-operatively, the casted legs may be incorporated into one unit through the addition of circular plaster-of-Paris at the point of juncture between the two casts and through the plaster incorporation of a wooden strut at a second point at which the casts are distant from one another, a temporal matter of but a few minutes.

FIG. 3

(Upper left) Wound of left proximal tibia and fibula with only a small remaining amount of tibia. Tibial plateau intact. (Upper right) Pre-operatively applied plaster-of-Paris casts with operative windows and inset vertical metal pieces visible. (Lower left) Right medial calf flap migrated to left anterior leg. Two casts incorporated into one immobilization device by means of two perforated metal bars. A third metal bar reinforces the cast on the right. (Lower right) Open-pedicle flap severed and final margin sutured into place. Full thickness skin and tela subcutanea afford adequate operative field through which subsequent bone graft to left tibia may be done.

Photos by Signal Corps, U. S. Army and U. S. Army

position, thereby inviting possible infection. This is obviated by the former method. The author has had infection in none of the thirty-five cases performed in the pre-casted manner.

DOUBLE-TIMED ARTERY LIGATURE

Early Report

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Sofia, Bulgaria[1]

The ligature of some big arteries causes in a certain number of cases severe and irreparable complications. A quickly-developing gangrene appears in the limbs, making amputation inevitable. According to Wolff, both necrosis and gangrene occur in the limbs after the ligature of the internal iliac artery in 50% of the cases, of the femoral artery in 25%, of the popliteal artery in 14%, of the femoral below the deviation of the femoral profunda artery and the circumflex arteries in 12.7%, of the external iliac artery in 12.2%, of the axillary artery in 15%, of the subclavian artery and the brachial artery in 4.8%. A cerebral softening, followed by a hemiplegia, developed in 55.5% after ligature of the common carotid artery. This serious complication defines the carotid artery ligature as a most dangerous and undesirable operative action for the patient as well as the surgeon.

The complications mentioned above can be avoided or minimized to a large extent by making the artery ligature in such a way as to enable the collateral blood circulation to get ready to meet the sudden loss of the big vessel. This particular method, we think, is found in the double-timed ligature which we applied as an experiment in three hopeless cases of cancer. The ligature of the common carotid artery in the cases mentioned above appeared as an urgent operation owing to erosive hemorrhages already existing in two cases and threatening to appear in the third one.

The double-timed ligature is done in the following manner: In the first operation the artery is not tied completely. By means of a thick silk thread it is tied loosely enough to let a blood current, slightly perceptible by finger touch, flow through. Either distal or cranial from the deposited ligature a second thick silk thread is passed around the artery; with this, a little later (after fourteen days) the artery is tied completely. In order to find this thread easily during the second operation, and chiefly to reach the artery without any difficulty, we leave a little rubber pipe (one-half inch in diameter) in the operative wound. We affix the pipe with a thread vertically to the surface of the body and through it we pass the thick thread with which, in the second operation, we shall do the final ligature (fig. 1). The rubber pipe should be long enough to fill the space from the artery to the subcutaneous fat tissue. Its end lies directly under the skin seam. Thus the pipe prevents the growing together of the soft parts which follows the first intervention in the place which leads directly to the artery, and makes it easy to locate the slightly pulsating and reduced in lumen artery.

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The operative "prep" is done through the windows in either cast. The casted legs are most easily draped by rolling them with two layers of sterile stockinette and placing them upon sterile sheets. Stellate cuts are made in the stockinette over the windows, and the excess stockinette is pushed under the margins of the cast windows with an instrument that is then discarded. The donor area is draped in routine fashion if the thorax or abdomen is selected as the donor site. The use of the thigh as a donor site is to be discouraged, for the pressure dressing necessary to the donor area might deprive that extremity distal to the dressing of optimum circulation.

Immediately prior to the migration of the flap, a small cut is made in the sterile stockinette over the vertical metal pieces, which are then prepped with a strong antiseptic as they slide through the cuts into the sterile field. The long perforated metal bars, the nuts, and the bolts are autoclaved prior to operation.

CONCLUSIONS

1. Pre-operatively applied, mated, plaster-of-Paris casts afford the patient better protection from pressure ulcers during the three to four weeks that he is immobilized and give him more comfortable casts that will require fewer alterations in the ensuing days.
2. The surgeon's time is reduced upon the operative day.
3. Trauma to the pedicle flap is reduced because the casts have been applied prior to the migration, eliminating movement of the pedicle flap inherent in plaster application.
4. The windows in the casts through which the surgery is performed expedite the post-operative care and the visualization of the flap and grafted donor area.
5. The possibility of infection is reduced as the flap may be covered with a sterile dressing at the conclusion of the operation and need not be open and in view while a post-operative cast is applied.

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up and hanging tumorous part with the help of an electric cautery. Then we made the double-timed ligature of the common carotid artery within an interval of fourteen days. The patient stood the operation well. No disturbances appeared either in the eye or in the brain. The hemorrhages ceased. The ligature of the carotid artery enabled us to remove a huge tumor, which was defined long ago to be an inoperable case. This was done in an operation which followed the ligature.

2. In the second case the patient had a cancer in the nasal cavity. In the course of three years he had undergone four operations and the necessary x-ray treatment. The tumor nevertheless kept on appearing again, and grew bigger.

FIG. 2

Hemorrhages from the depth occurred, exhausted the man, and kept him in constant fear. When we examined the patient, we discovered a crater-like opening which occupied the nose, the left orbital and the left upper jaw region, and extended deep toward the base of the skull. We undertook the double-timed ligature of the common carotid artery, owing to the frequent erosive hemorrhages. In this case, too, the post-operative period passed without any complications on the part of the brain. Hemorrhages stopped.

3. The third patient came to the hospital with a lymphosarcomatuous tumor in the neck region. A ligature of the common carotid artery was made with the purpose of preventing threatening erosive hemorrhages and easing the imminent operation. In this case, too, no complications appeared.

These clinic observations are too few in number to be able to prove beyond doubt the benefit from the described method of ligating an artery. We make this early report in the desire to provoke the interest of a larger circle of surgeons. A similar operation in the limbs is to be tried, and research with animal should also be made.

The technical preparation for the forthcoming second operation is exceedingly important for the double-timed ligature of the common carotid artery, because the complicated topographical conditions (vagus nerve, carotid sinus, internal jugular vein, et cetera) become still heavier by the inevitable post-operative growing together of the soft tissues.

After fourteen days, by means of the ordinary skin cut, we can easily locate the rubber pipe, pull it out of the wound, and then have at hand the thick silk thread which we have put around the artery. Thus we have a free approach to the artery. All we have to do is tighten up the thread and achieve the complete and final ligature of the artery. The fourteen-day interval between the first and the second intervention serves to create a collateral blood supply which is sufficiently strong enough to prevent gangrene or cerebral softening. Further clinical experiment will decide whether this short period will suffice to achieve

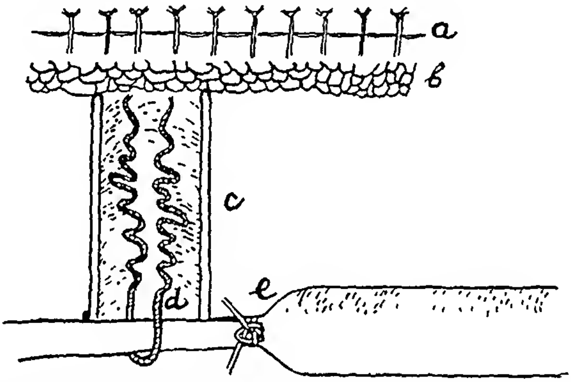

FIG. 1. a) Skin seam, b) Subcutaneous fat tissue; c) rubber pipe; d) silk thread put through and placed in a rubber pipe with which the definite ligature will be made; e) First incomplete ligature which enables a slight blood flow to be felt.

our purpose, or whether it should be prolonged. According to our experience, the most substantial stimulus for bringing into action the collateral blood circulation is the first incomplete ligature of the artery. This ligature should be strong enough to cause a sufficient oxygen hunger in the corresponding tissue region. This oxygen hunger will by way of reflex action provoke the saving pressure of the collateral blood stream.

A FEW WORDS ABOUT OUR CASES

1. This ligature of the common carotid artery was tried for the first time on a recidivous malignant tumor in the neck and jaw region. The patient had already been operated upon for a mixed tumor of the parotid gland, but soon the tumor appeared again, this time bigger than before (fig. 2). Incessant pain and several severe hemorrhages in the tumor masses brought the patient to the point of death. In order to have a clean operative field, we removed the grown

SYNOVITIS OF THE WRIST

THOMAS W. STEVENSON, M.D.[1]

New York, N. Y.

The tendon sheaths of the wrist have demanded much attention from anatomists and surgeons. Acute suppuration has provided the greatest stimulus for study of these structures. Doctors Auchincloss, Bunnell, Kanavel, Koch and Mason have each made great contributions to our knowledge with immeasurable benefit to our patients. We have all experienced relief as chemotherapy has removed the necessity of fighting infections with the knife alone. The synovial surfaces are subject to injury other than suppuration and some of these conditions are of great interest.

Before referring to these disorders it will be well to remember the function of the synovia which is to reduce friction at points where power is transmitted around a corner. Several portions of tendon are tightly enclosed in a canal, partly bony, and partly fibrous. The canal is lined by a parietal layer of synovia, and the tendons surrounded by a visceral layer. Normally there is scant fluid. Fluid forms usually as a result of irritation. Illustrations of the tendon sheath show a fully distended structure that would only be seen in a state of disease. Gray's Anatomy contains these two drawings which show the synovial distribution at the wrist. There are numerous variations, particularly as to communication between the different sheaths.

The largest area of synovia surrounds the flexor tendons beneath the transverse carpal ligament. The thumb and fifth finger tendons are covered by synovia to their insertions, while the sheaths to the middle three fingers terminate in mid-palm. There is a sheath about the flexor carpi radialis where it runs through the transverse carpal ligament, and the groove of the greater multangular.

Friction points on the dorsum of the wrist are similarly located beneath the dorsal carpal ligament. However, none of these sheaths extend to the fingers. On the radial side a sheath surrounds the abductor pollicis longus and extensor brevis. Next is a sheath around the extensors carpi radialis, longus and brevis, and across this the sheath of the extensor pollicis longus. The large central sheath covers the extensor digitorum communis. The extensor digitis quinti is separately sheathed, and the last one on the ulnar side is the flexor carpi ulnaris.

In each case it is important to note that the sheaths extend well above and below the transverse ligaments, and a considerable pantaloon-like invagination serves to permit free excursion of the tendon. When pathologically distended this allows the sheath to appear to extend further than normal along the tendon.

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Delivered, January, 1947, at the American Society for Surgery of the Hand meeting in Chicago.

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Effusion of synovial fluid denotes irritation, and irritation may be entirely mechanical in nature. Wear at a friction point can be hastened by increasing the pressure or frequency of excursion. This is seen in workers who have to

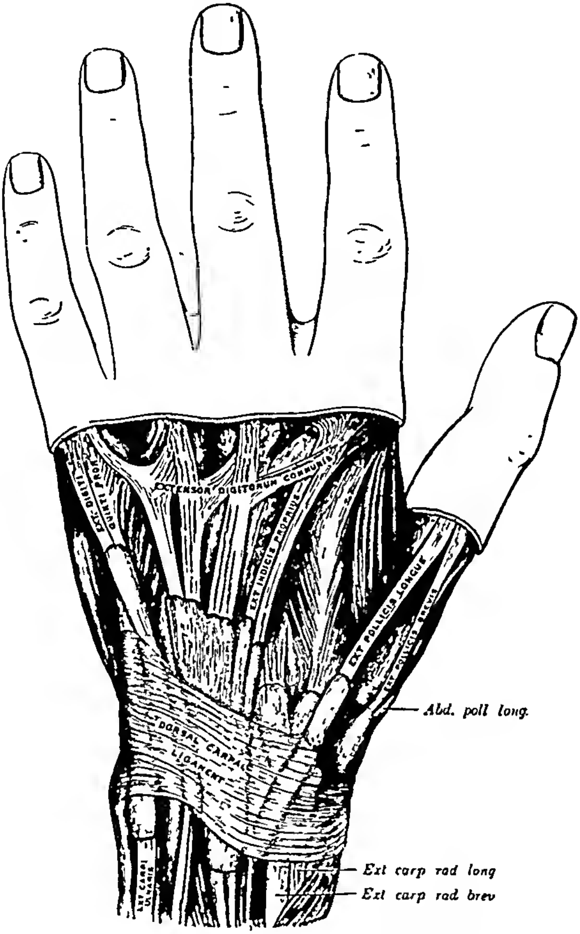


Fig. 1A

Fig. 1. Distribution of Extensor Sheaths-distended. Distribution of Flexor Sheaths-distended

(Gray's "Anatomy," 24th Edition, Philadelphia, Lea and Febiger, 1942.)

repeat a forceful operation as that of shaping a felt hat over a mould, stretching sails, or as in one of our nurses who manually wrung out hundreds of hot and cold towels in a three day period of Kenny treatment. One might compare this process to the formation of a blister by friction on the skin. Damage is produced more rapidly than it can be repaired. Pain and effusion tend to diminish the

wear, and the rest permits repair. When a sheath is thus irritated there is generally roughness noted by the patient as a grating sensation, and felt or heard by the physician as crepitus. This is best detected on the first motion after a period of rest. Pain, worse on motion is characteristic. Crepitus and pain diminish as effusion increases. Sometimes crepitus and pain are features

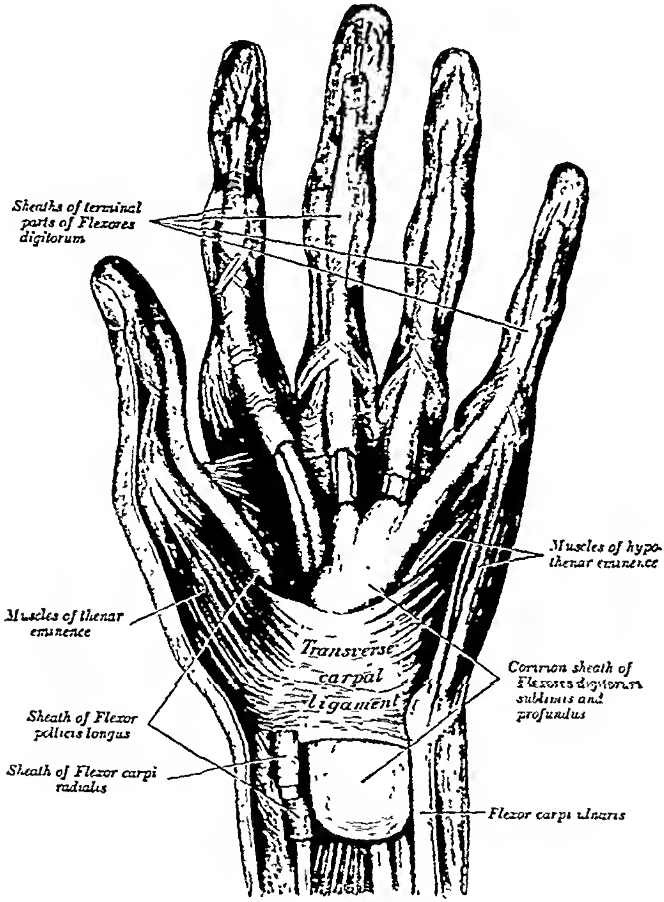


FIG 1B

with little effusion. Rest is the most important therapeutic indication and prompt cure is the rule. In cases of less acute onset or long repeated trauma, more permanent changes may take place. These changes are of three forms or a combination. A moderate effusion may persist accompanied by progressive thickening, congestion, and corrugation of the synovia.

In some instances the surfaces are thickly covered by villi of varying size.

When first exposed the sheath is several times thicker than normal, and the lining surface is velvety, and reddish-purple in color. In other instances fibrosis is the feature. As a result of this tendon motion becomes more and more restricted.

A

B

Fig 2. Bilateral Traumatic Synovitis before and after Synovectomy

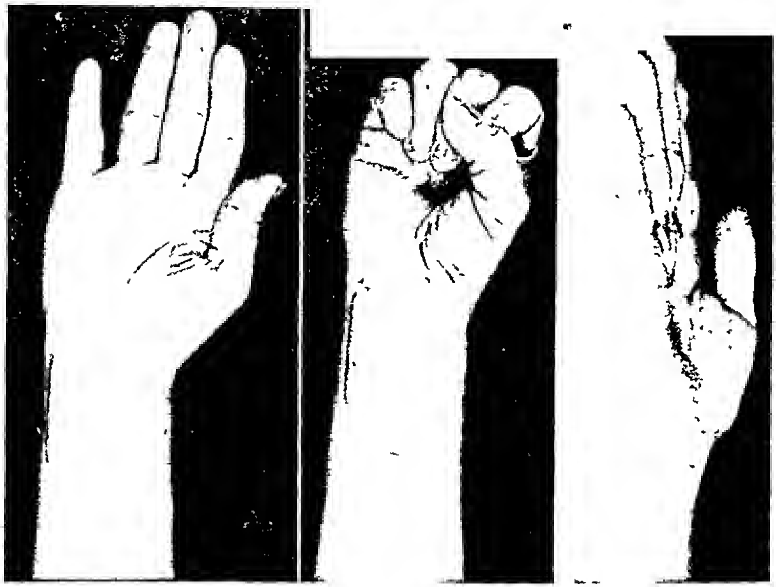
At some times the greatest damage is seen in the tendon. Fibres may be separated into several bundles with pale, edematous, almost cystic, protruding masses. One advanced case has been seen in which the swelling was so great that under continued stress the weakened tendon finally separated. This seems

to compare with attrition of the long head of the biceps as described by Meyer (1). A case illustrating this type of synovitis has been selected for brief presentation.

A B

FIG. 3. TUBERCULOUS EFFUSION IN RADIAL AND ULNAR BURSA AND COMMON FLEXOR SHEATH

I. J. was a 15 year old Scandinavian girl who had noted a small lump on the dorsum of each wrist two years earlier. She did hard work in their household, including scrubbing and wringing clothes by hand. She had some pain when using the wrists forcibly, and the swellings slowly increased. Her general health was excellent, and aside from discomfort had no complaint except that she could not flex the wrists as far as normal. The largest swelling measured 4.5 x 5 cm. and most of the extension was distal to the dorsal carpal ligament. The distal edge moved to and fro with excursion of the middle three extensor



A B C

Fig. 4 Appearance after Synovectomy. Note Stepped Incision

Fig 5 Dorsal Kyphosis

A

B

FIG. 6. TUBERCULOUS SYNOVITIS WRIST AND MIDDLE METACARPOPHALANGEAL JOINT

tendons. A soft crepitus was easily felt by the patient and examiner. The mass was softer than a ganglion and much more diffuse. It did not become harder when the wrist was flexed. On December 29, 1934, all excisable synovia was

A

B

FIG. 7. APPEARANCE AFTER SYNOVECTOMY

removed. It was thick, purple, and villous. The tendon to the middle finger was three times normal size in a 3 cm. segment, and the fibres were split apart by edematous, avascular tissue similar to some of the larger villi. The other

tendons were covered by shaggy synovia. The bulk of the enlarged tendon was reduced to normal calibre by excision of the abnormal tissue and the carpal ligament repaired. Areolar tissue and skin were replaced and the arm and hand splinted for three weeks.

Microscopic sections showed great fibrosis, mild lymphocytic infiltration, and a great deal of fibrin in all stages of organization. No tubercles were found. Cultures and guinea pig inoculations were negative.

On July 24, 1936, the left wrist was explored through a transverse incision and similar pathology found, except there was less fluid and more and larger villi. Large yellowish villi spread between the tendon fibres of the middle and

Fig. 8. Recurrent Effusion after Four Months Destruction of Adjacent Bones

ring fingers. Laboratory findings were the same as before, and wound healing was uncomplicated. Splinting was again done for three weeks.

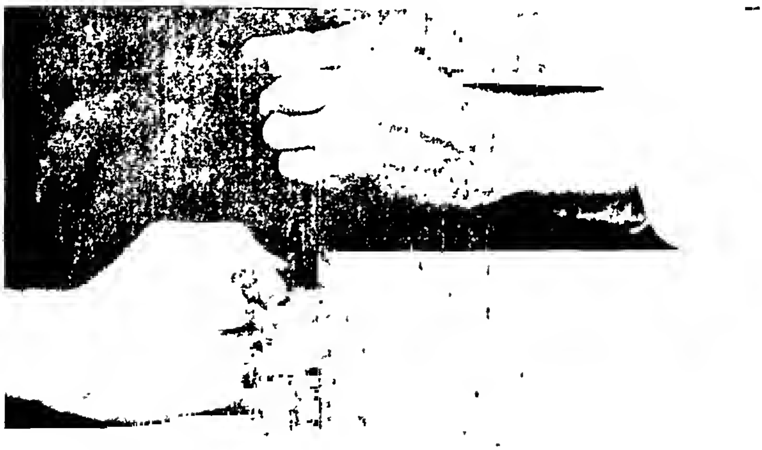
In May 1940 the patient was lost to follow-up. At that time she had full function without symptoms, and was working as a typist.

Differential diagnosis is not difficult. The location and softness rule out all solid masses except lipoma. On first inspection one may think of a ganglion, but this lesion is smaller, harder, and sometimes lobulated. Ganglion may be considered to arise as a form of sharply localized synovitis of tendon sheath or joint. For brevity consideration of this lesion is being omitted at this time.

The same factor of repeated trauma often found in chronic tenosynovitis is usually present in cases of tuberculous synovitis. History and clinical findings may be the same as in ordinary synovitis. Indeed it is often impossible to prove the diagnosis, even with smears, culture, guinea pig inoculation, and microscopic sections.

Of the five patients I have had an opportunity to study in detail two were not operated upon, but they both had proven tuberculous lymphadenitis. One was

A

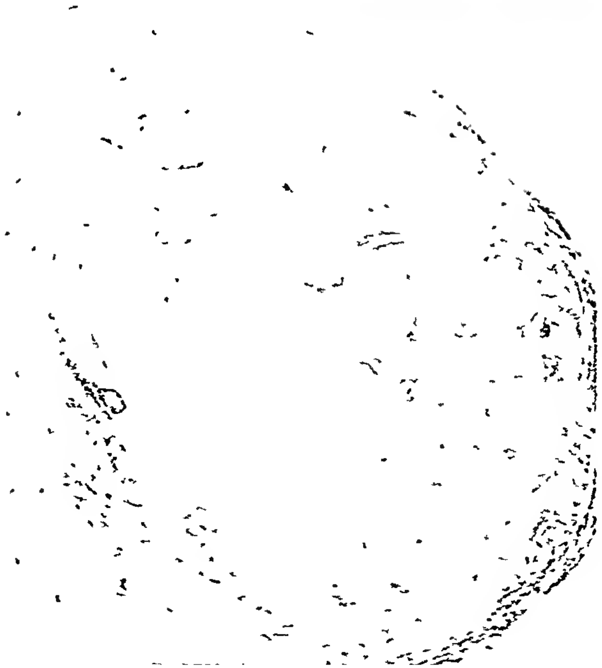


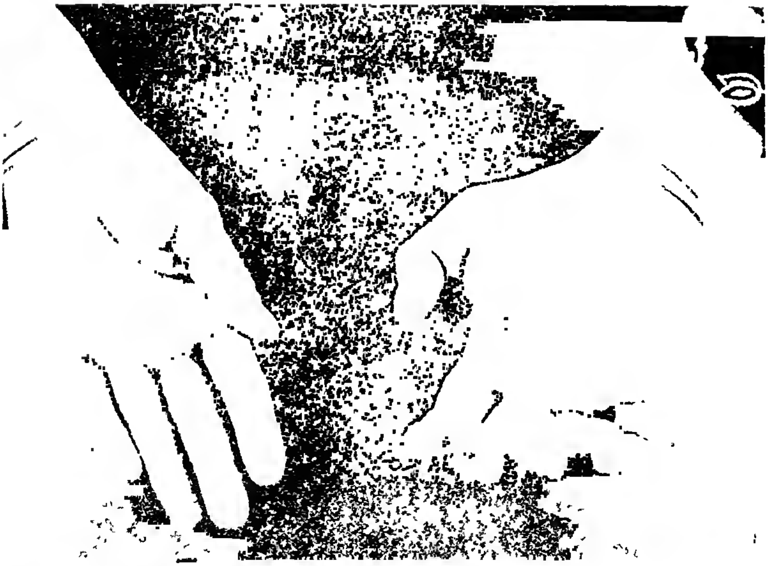
B

FIG. 9. JOINT AND SYNOVIA EXCISED

an emaciated woman stenographer of 33 who had had the right axillary nodes resected on March 8, 1929, for tuberculosis. She had calcified cervical nodes. In September 1936, she developed synovitis of the common extensor sheath of the right wrist. The mass measured 5 x 10 cm. Her local doctor had tried to

A





A

B

Fig. 11. Lipoma Beneath Flexor Tendons with Bulge in The Hypothenar Region

break it by striking it with a book. She came under treatment November 20 1936, two months after onset. Splinting, elevation, and a hygienic regime was started. Swelling slowly subsided and limited use was permitted after five weeks. The swelling disappeared completely and she gained weight. On December 15, 1941 she was still free of symptoms.

The other unoperated patient was a 23 year old colored stenographer who had a two year history of draining sinuses in both sides of the neck, proven to be tuberculous. He was under treatment of the general surgical service starting in October 1935. In December 1935, he had developed increasing swelling on the dorsum of each wrist. The larger one measured 3 x 4 cm.

The cervical disease forced the patient to stop work, and he was several times admitted for excision of all cervical nodes, including the submental, which were involved. He also had a tuberculous abscess of the scalp. Upon rest the wrist swelling subsided, and after one year no abnormality could be detected. His general condition improved, and in July 1945, all of his wounds were healed. A 10 year period.

Photographs of the 3rd patient show very extensive involvement of the common flexor sheath with extension down the radial and ulnar bursa. The patient was a 38 year old woman who had done hard manual work on a machine job for 12 years. The work was too hard and she changed to housework. Her wrists had become more swollen and sometimes painful for 3 years. Her general condition was good, except that several pea-sized shadows were noted near the left lung hilum. A synovectomy was done October 25, 1935. There was a little fluid and about 150 c.c. of rice bodies varying in size from rice size to bean size. They were a little lighter in color than fat lobules. Here was an example of how rice bodies are formed. A rice body is evidently the end stage of a villous. The synovial surface varied from the usual velvety appearance to a very coarse surface. Many larger villi were of the shape of a tenpin. Others were attached by a very thin filament, but most were free. Cultures were sterile, and no microscopic evidence of tuberculosis was found. Guinea pig inoculation was positive. A good result was obtained on the hand, but in February 1936, the patient appeared with a dorsal kyphosis for which she was immediately sent to the New York Orthopaedic Hospital, where a fusion was successfully done. In August 1937, she was found to have bilateral renal tuberculosis. She died in May 1941, with tuberculous peritonitis, cystitis, and nephritis.

The 4th patient was a 43 year old shipyard worker whose job was to chip off old paint. For 9 months he had had a swelling on the dorsum of the wrist and another over the knuckle of the middle finger. He noted that these became harder when he worked, and softer if he rested. His work-up was entirely negative, and on May 6, 1943 excision was done. The synovia of the 3rd metacarpo-phalangeal joint was not excised.

All tests including guinea pig and microscopic examination were negative for tuberculosis. Induration remained over the metacarpal head and in September, 4 months after operation, a soft mass was present. X-rays showed areas of rarefaction in the adjacent metacarpal, and phalanx. Finally despite

A

B

FIG 11 LIPOMA BENEATH FLEXOR TENDONS WITH BULGE IN THE HYPOTHENAR REGION

Again all laboratory data was negative until finally the decalcified bone specimen showed tubercles. The patient has resumed his regular work and when last seen on February 1, 1946, he had good motion in the false joint.

The most recent tuberculous synovitis case is still under treatment. She is a 38 year old colored woman who had disease of the common flexor sheath with spontaneous division of the flexor profundus to the 5th finger. Tuberculosis was proven pathologically but not bacteriologically. Synovectomy was done

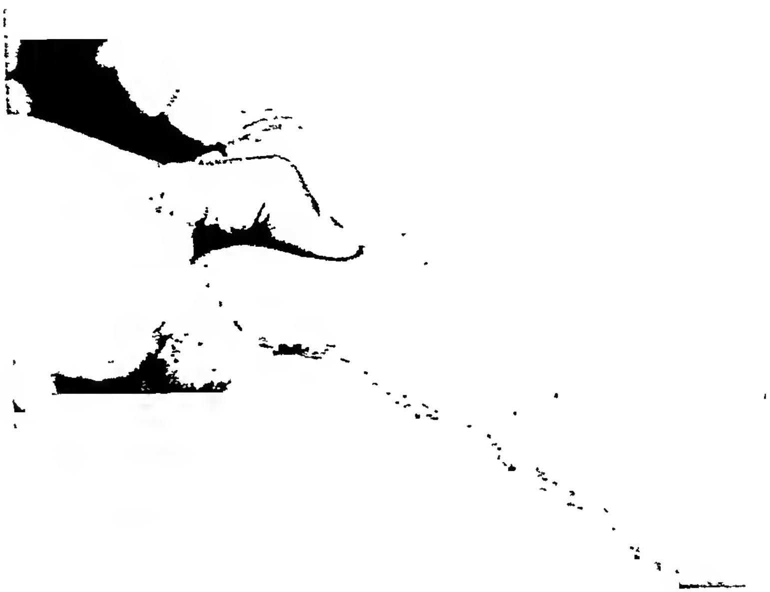
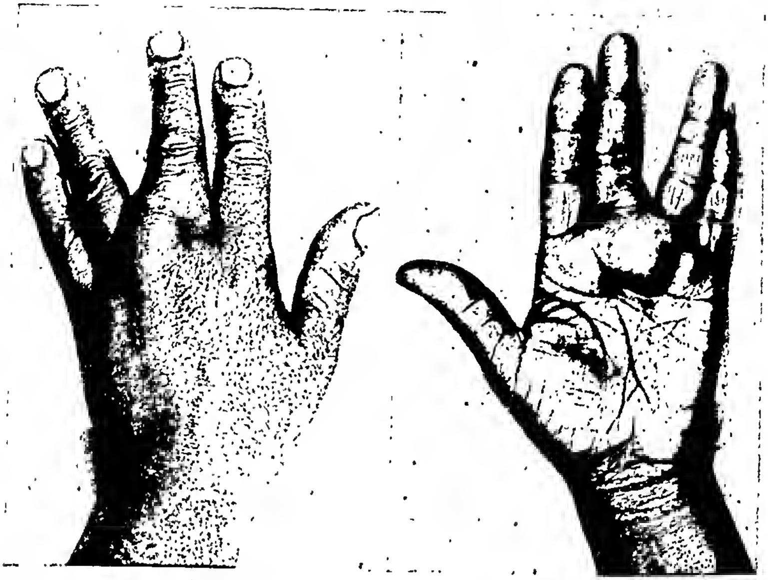


FIG. 14. LIPOMA COMPRESSED BENEATH TRANSVERSE CARPAL LIGAMENT

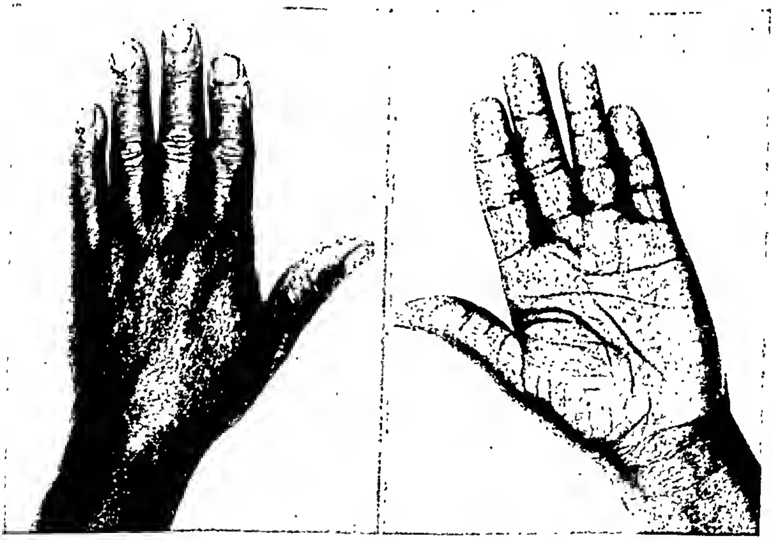
November 9, 1944 and the tendon repaired by suturing the distal end of the profundus to the proximal end of the sublimus. She has been well until December 26, 1946, when a soft swelling appeared above the carpal ligament. She has no other evidence of disease and is being splinted at present.

As stated earlier lipoma is about the only condition which might be confused with synovitis with effusion and photographs are presented to show this. One shows lipoma located beneath the flexor tendons and bulging in the thenar and hypothenar areas. Pressure on one bulge increased the fullness on the other side suggesting fluid. Anterior pressure is so great on the tendons that the fingers are partially flexed. Another lipoma extended through the hand from front to back and pseudofluctuation could be elicited. Fluctuation was so evident that another physician had attempted to aspirate the lesion. Finally a



A B

FIG. 12. LIPOMA OF PALM WITH EXTENSION TO THE DORSUM OF THE HAND



A B

FIG. 13. AFTER EXCISION FROM PALMAR ASPECT

rest the mass measured 7 x 8 cm., was bluish in color, and threatening to break down. On January 15, 1944, the synovial sac and joint were excised.

SUBLIMIS TRANSPLANT TO RESTORE ABDUCTION OF INDEX FINGER*

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In a motor paralysis of the ulnar nerve or in direct trauma to the first dorsal interosseous muscle, the resulting inability to abduct the index finger prevents a useful grasping mechanism between the thumb and index finger. There is inability to grasp any objects firmly except by completely opposing the thumb and using the long flexors of the fingers.

Our first attempts to restore this lost motion to the index finger were made by using the extensor indicis proprius. This was rerouted subcutaneously over the first dorsal interosseous space and inserted into the radial side of the base of the proximal phalanx of the index finger. This produced a fairly satisfactory result, but there was a tendency for this to also act as an extensor of the index finger while the abduction was being carried out. It also did not possess the desired amount of strength. The extensor hallicus brevis has also been used but is lacking in strength. Sublimis tendons had been transplanted to restore other lost motion, so were tried here. The results were very gratifying. It resulted in a strong grasp between the thumb and index finger and did not have the tendency to extend the fingers simultaneously. Independent function was present in both types of transplants, but was more easily adapted in the sublimis transplants.

The sublimis selected is usually from the ring finger. It was desired not to disturb the index and long fingers as they are the most useful fingers. However, in some cases it was necessary to use the sublimis of the long finger because of the scarring of the ring finger and its flexors.

OPERATIVE TECHNIQUE

The sublimis is cut proximal to the interphalangeal joint through a short lateral incision, leaving a short stump of the sublimis to reattach to the proximal phalanx and thus prevents a hyper-extension deformity of the joint. Its two slips are split proximally to allow its withdrawal from around the profundus tendon. It is withdrawn at the wrist through a transverse incision just proximal to the flexor crease. The volar fascia of the forearm is opened proximally, sufficiently to allow the sublimis to be brought around the radial side of the forearm without undergoing acute angulation. A subcutaneous

* Presented at the Meeting of The American Society for Surgery of the Hand, Chicago, January 1947.

lipoma of the flexor surface was found to extend above and below the transverse carpal ligament, and could be pressed from one side to the other. History and physical examination may be confusing. Crepitus is notably absent in lipoma.

SUMMARY

The anatomy of the sheaths of the wrist has been reviewed and irritation of the sheaths discussed omitting acute infections and ganglion. Acute traumatic synovitis should be distinguished from chronic villous or stenosing synovitis. Villous invasion or disruption of the tendons has been seen. Examples of tuberculous synovitis have been presented and finally reference made to the fact that lipoma may simulate synovitis with effusion.

REFERENCE

1. MEYER, A. W.: Spontaneous Dislocation of the Tendon of the Long Head of the Biceps Brachi. Arch. of Surg. 13, 109–119, 1926.

FIG. 1

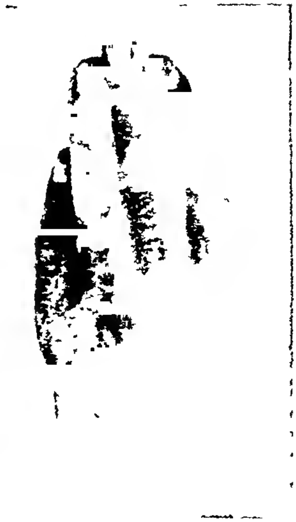

FIG. 2

FIG 3

CASE III. FIRST INTEROSSEUS FUNCTION LOST BECAUSE OF NERVE INJURY FUNCTION RESTORED BY SUBLIMIS TRANSPLANT USING THE SUBLIMIS OF THE RING FINGER FIGS. 1, 2 AND 3. SHOWING THE INDEX FINGER IN ABDUCTION, ADDUCTION AND GRASPING

sublimis tendon transplanted is always of sufficient length to be sutured into the proximal phalanx. The insertion of the sublimis can be either to bone on the radial side in the shaft of the proximal phalanx, or it can be sutured to

pathway is then made with a curved clamp behind the thumb, over the anatomical snuff-box and the first dorsal interosseous space out to the radial side of the

Fig. 1

Fig. 2

Case I

Fig. 1. Original View of Hand with Loss of Abduction of Index Finger

Fig 2. Final View with Index Finger in Abduction Showing the Transplanted Tendon Subcutaneously

Fig 1

Fig 2

Case II Loss of First Interosseus Due to Penetrating Bullet Wound

Fig. 1 and 2 Final Views with the Index Finger in Abduction and Adduction

proximal phalanx of the index finger. Exposure for the insertion of the tendon is through a short incision on the radial side of the base of the index finger. The

A CRITICAL REVIEW OF RECENT LITERATURE ON RHINOPLASTY

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In the past ten years there has accumulated vast literature on rhinoplasty. Some of it has been instructive because it is based on actual experience, but a considerable portion has been not only confusing but detrimental to the rhinoplastic surgeon because it is premised on theory and fallacy.

Therefore, it is my intention to review a number of the more recent articles on this important subject, evaluating them by the criteria of a personal opinion which has been crystallized in the performance of thousands of rhinoplasties. I trust that any criticism forthcoming will be accepted in the constructive spirit in which it is offered.

First, I believe that the most common fallacy encountered in recent literature concerns the "tie in" theme. In accordance with this theory, art, mathematics, and microscopic anatomy are granted very important rôles in rhinoplasty. Men of experience will recognize readily the irrelevancies in such articles, but younger men may be confused. For example, Griesman (1) places great stress on the rôle of the nasal muscles.

His article on the muscles and cartilages of the nose is an excellent résumé of the works of various anatomists, and defines minutely the actions of the different muscle fibers about the nose. Not only is their importance in relation to rhinoplasty greatly exaggerated, but the maneuvers which he describes to avoid injuring these mainly vestigial muscles are impossible to carry out. These muscle fibers play an insignificant part in the performance of a rhinoplasty, and have no influence on the final result, providing the usual, well-established surgical procedures for changing the form and size of the bones and cartilages of the nose are followed.

From a practical standpoint, I think the musculature of the nose may be entirely disregarded, for I do not believe that anyone can carry out the techniques described in that article, with a view to preserving the muscle fibers of the nose. Since most steps of a rhinoplastic operation are performed subcutaneously, the surgeon depends a great deal on the sense of touch in the fingers of the left hand, to guide him in re-shaping the structures which form the framework of the nose. The sense of touch also directs his instruments into proper planes of cleavage. However, I have yet to see or feel a nasal muscle in the course of a rhinoplasty.

The natural healing process following any surgery involves the formation of scar tissue. This explains the partial fixation of the skin of the nose to the underlying structures after a rhinoplasty. This fixation, which is partly caused by round cell infiltration, diminishes in time, so that the natural ability of the patient to wrinkle the skin of the nose or to dilate the alae is not appreciably impaired.

the intrinsic sleeve and first dorsal interosseous tendon at the same level. We have observed no difference in the function of the two types of insertion.

We believe that it is necessary to bring this sublimis tendon behind the thumb and over the anatomical snuff-box and first dorsal interosseous space in order to get the proper direction of pull for abduction. If this tendon were brought in front of the thumb through the lumbrical canal, it would act as a flexor.

Postoperative immobilization consists of keeping the finger in abduction and extension and keeping the wrist flexed slightly to relieve the tension during healing. It is kept in this position for three weeks, and then the splint is removed and the patient taught to use the transplanted tendon. It is frequently surprising to see the patient use this transplanted tendon without any re-education. Occasionally, however, an individual will be unable to learn how to individually control this transplanted tendon. In these cases the tendon has an automatic function and acts as an abductor when the fingers are flexed. They are unable to abduct the index finger voluntarily, but the transplanted tendon will function as an abductor when an object is grasped between the thumb and index finger.

This same method of transplanting the sublimis tendon has been used to restore abduction (radial motion) of the long finger when the index finger has been amputated and the second dorsal interosseous function lost.

A method of transplanting a sublimis tendon to restore abduction to the index finger has been presented. The sublimis tendon, either of the long or ring finger, is cut from its insertion at the level of the proximal interphalangeal joint. It is withdrawn at the wrist, passed behind the thumb, and over the first dorsal interosseous space and sutured to the first dorsal interosseous tendon and radial side of the index finger. Postoperative immobilization of the finger in abduction and extension is maintained for three weeks. Re-education is then undertaken. This restores a more normal grasping mechanism between the thumb and index finger.

comprises that part of the septum which lies in front of the anterior nasal spine, the lateral cartilages, which usually blend into the septum, and the alar cartilages with their columellar extension, which form the tip of the nose. The anterior nasal spine may also be included, since it is often involved in nasal malformations.

Then too, in civilian practice, the majority of nasal defects which we encounter are hereditary. They follow a definite pattern in resemblance to either one of the parents or grandparents. Yet, it is surprising to learn how many patients like to trace their defect to some slight trauma which could not possibly have had any influence. The familial pattern of the nose is quite obvious, but it seems to satisfy their ego to blame some fortuitous little incident.

True, there are a considerable number of traumatic deformities of the nose. These are of two types: the purely traumatic deformity which disfigures an esthetically normal nose; and the one in which trauma adds an additional element to a hereditary esthetic defect of the nose. Traumatic deformities of the external nose are frequently accompanied by injury to the septum. Fractures and dislocations of the septum may produce secondary changes in the inner chambers of the nose. They may cause pressure on the lateral nasal wall and interfere with the normal drainage of the sinuses, and they may also bring about otitic changes by increasing the air pressure in the nasopharynx.

In such cases the patients frequently suffer from a physiologic disturbance of the respiratory passages, which may require expert intranasal surgery or intensive and prolonged treatment to clear up the secondary sinus infections, or any other intranasal or otitic complications that may have arisen. The external deformity is a matter of secondary consideration, and its correction can and should be postponed until such time as everything possible in the way of a cure for the intranasal condition has been effected.

Thus, we cannot agree with Ersner (3) that it is the duty of the rhinologist to correct a cosmetic defect of the nose as an incidental procedure in connection with his intranasal work. The following is a quotation from Ersner's article:

> "Many rhinologists have been particularly lax in their approach to the correction of the external deformities. As a rule, they perform the submucous resection hut hesitate to correct the external deformity. This has invited the cosmetician to enter the profession and has allowed many Quasi-Rhinogists, who style themselves "plastic surgeons" to invade the specialty."

Coming from Dr. Ersner, these are strange sentiments. He received his own training in rhinoplasty from men who are not rhinologists. We should also like to remind him that Professor Jacques Joseph, who devised most of the modern rhinoplastic procedures, was not a rhinologist; nor are Blair, Brown, Pierce, or Aufricht, to mention but a few surgeons who have made valuable contributions to rhinoplasty. Therefore, instead of chiding some of his rhinologist colleagues for refusing or failing to perform rhinoplasties, he might have complimented them for using good judgment. Too many of them have through bitter experience involving surgical disfigurements come to the conclusion that rhinology and rhinoplasty are not very closely related.

The only real relationship between rhinology and rhinoplasty is geographic.

The muscles which control dilatation of the alae nasi are well developed in some individuals, and practically absent or inactive in others. The great amount of dilation of the alae of which some persons are capable is usually the result of constant practice during the formative years. At first, it is merely a form of childish amusement, but eventually it becomes a habit that is difficult to break. We have had patients who consulted us for the purpose of doing something to remedy this habit. We have undermined the skin of the alae extensively; we have deliberately snipped with scissors and nicked with scalpel every possible location of muscle fibers about the alae. The result was good only so long as the swelling and tenderness of the parts lasted. Then, gradually, the habit was reinstated and became as active as before the operation. Similarly, we all know of many people who are capable of wiggling their ears by exercising the vestigial muscles in this region. Yet, when we correct protruding ears in such an individual, we pay absolutely no attention to these muscles, because they are of so little importance.

In an article on "Failures in Rhinoplastic Surgery" (2) I made a survey of many surgical disfigurements caused entirely by amateruish or incompetent surgery. I found none that could be ascribed to injury of the muscle fibers of the nose. I therefore do not agree with Greisman that a rhinoplasty is as complicated a procedure as he makes it appear by ascribing such unusual importance to the muscle fibers of the nose. Had I been confronted in 1921 with these seemingly insurmountable obstacles and the fear of cutting through a few unimportant muscle fibers, I never would have performed the many thousand rhinoplasties I have done with such gratifying results.

The same author further contends that for the purpose of resecting a nasal hump the undermining of the bony dorsum should be done subperiosteally in order to preserve the procerus muscle in the region of the glabella. This can rarely be accomplished without considerable mutilation of the periosteum, and the creation of a mass of periosteum and muscular fibers in the region from which the nasal hump has been removed. Because periosteum is non-contractile, it will not adjust itself to the smaller framework. It is our contention that wherever a portion of bone is removed, its overlying periosteum should be excised with it, unless the surgeon is hoping for regeneration of bone from the remaining periosteum. While this might apply in general bone surgery, where pathology indicates bone removal, it does not pertain in rhinoplasty, where an excess of bony structure is to be reduced for purely esthetic reasons.

Thus, it cannot be stated too strongly that the teaching of such a specialty as rhinoplasty should be made as concise and understandable as possible. The introduction of extraneous or irrelevant matter tends to confuse the student and retard him in the attempt to form a clear mental picture of the real problems involved in the performance of a rhinoplasty.

In this type of surgery we are dealing primarily with esthetic defects of the external nose, which is not a complicated organ. It consists of the following bony structures: the frontal processes of the superior maxillae, the nasal bones, and the radix nasi, which constitutes the glabella. The cartilaginous portion

drugs and penicillin in the treatment of otitic infections, and the consequent drop in the number of mastoidectomies. Of course, this may be purely coincidental, but the fact remains that the treatment of nasal pathology and the correction of hereditary or traumatic nasal malformations are two separate problems.

In a very descriptive and interesting article on the "Physiology of the Nose from the Standpoint of the Plastic Surgeon," Arthur W. Proetz (5) points out that there is but one important element associated with the external nose which may influence the direction, the shape, and the speed of inhaled air currents. That is a constriction occurring about 1 cm. from the external orifice. "This is comparable to the nozzle of a hose (which) . . . directs the air stream upwards, where most of it passes through the olfactory fissure close to the septum and continues in a high arch to the face of the sphenoid bone and through the choanae to the pharynx." This important anatomic formation is not usually affected by the mere fact that the nose is humped, bulbous, too long or too wide, or in any other way esthetically unattractive. We have, however, seen several cases where a stricture at this point was produced when a submucous resection and a rhinoplasty were combined.

Dr. Proetz points out, too, that is is not enough that the total capacity of the nasal chambers be sufficient to permit free flow of a volume of air adequate for respiration. It is equally important that the two sides be almost alike; for if a disproportionate amount of air is forced to enter through one side, that side tends to become dry and then develop a metaplasia of the ciliated epithelium. At the same time, the relatively obstructed side is under-ventilated and likewise undergoes changes in the epithelium, which differ from those of the over-patent side but are equally unhealthy. He then goes on to say: "Deviations and irregularities in the bridge of the nose have relatively little influence on the physiology unless they extend far enough into the fossa to produce appreciable changes in the pattern of air distribution."

This, then, refutes the claim of some rhinologists that a rhinoplasty is merely another step in the course of a submucous resection. The external nose presents a complete problem of its own, and those who would undertake the task of remodeling a misshapen nose into one that has a pleasing appearance must possess special qualifications, besides a good understanding of nasal physiology and a proper respect for it.

In a review of several other articles on rhinoplasty, we have noticed a trend to invent a new nomenclature for anatomical structures or their relative positions. This creates such confusion that is is difficult to orient oneself without constantly drawing mental diagrams or feeling a desire to use a compass. For example, it is much easier to understand what is meant by the inner and outer surface of the nasal bone than by the ventral or dorsal aspects of that bone.

Prof. Jacques Joseph, who was my teacher and is considered the father of modern rhinoplasty, always spoke of the cartilago lateralis (lateral cartilage) and the cartilago alaris (alar cartilage). Even though the alar cartilage does not form the true ala, its absence is responsible for collapse of the alae. And since it has such an influence on the alae, it may reasonably be called the alar cartilage.

Thus, a man may be an excellent rhinologist and only a mediocre rhinoplastic surgeon, and vice versa. Of the many men I have trained, a former dermatologist and a young surgeon who had just completed his internship when he came to me are two of the most talented in this field. Neither one practices rhinology.

In the same article under the subtitle, "Injury in the Form of a Saddle Nose Created by a Submucous Resection," Ersner seems to have discovered an entirely new reason for a saddle of the cartilaginous dorsum of the nose. He denies that an excessive removal of the septal cartilage is the cause of the saddle deformity. It is a well accepted fact that there are but three causes for this deformity: namely, trauma with fracture dislocation of the septum; septal abscess with destruction of the cartilage; and, the most common cause, excessive removal of septal cartilage in a submucous resection. Does Dr. Ersner wish to imply that the rhinologist can do no wrong? The reason for the deformity, as given by him, is expressed thus:

> "This result is found in cases in which the upper lateral cartilages are short in their relationship to the quadrangular cartilage and the shortness of the upper lateral cartilages, rather than the complete removal of the ventral end of the septal cartilage being responsible."

Up to the present I have been unable to determine the exact meaning of that statement. It must be even more confusing to the younger men in the profession. It is most unfortunate that I must disagree so radically with Dr. Ersner in his comments on rhinoplasty, since I have always had great regard for him as an otologist.

I should also like to comment on Dr. Ersner's excursion into the field of obstetrics (4) and his using that as a "tie in" for an article on deformities of the nasal septum. As usual, the references and quotations from standard books on obstetrics in regard to head and pelvic measurements are irrefutable. But it does appear strange that it has never occurred to any of the many famous obstetricians that the nose of a newly-born infant can become such an important factor in dystocia.

It was Ersner's good fortune to discover an entirely new obstetric measurement: "The Occipito-Nasal." He states:

> "To our great amazement [and to mine, too] it was found that there was a variation of from 1 to 2.5 cm. of outward projection of the nose."

After reading this paper, I should like to make two observations. 1. In cephalic presentation, the infant's head is rarely, if ever, delivered in the occipito nasal position. 2. The average normal projection of an adult nose is 2 cm. A newly-born infant with a nasal projection of 2.5 cm. must be odd looking indeed.

Strangely enough, I have noticed the sudden resentment of some rhinologists to what they call an invasion of their territory by plastic surgeons. I have observed also that this resentment coincided with the introduction of the Sulfa

chewing food. The narrowing of the nasal bridge in the course of a rhinoplasty is a carefully planned infracture of the lateral walls, and behaves in the same manner as an unpremeditated fracture. If the bridge spreads, the fault lies in the fact that the fracture is incomplete (Greenstick fracture). Such a fracture has a tendency to right itself and broaden the nasal bridge. If the cancellous web in the radix nasi interferes with producing a complete infracture of the lateral walls, in the course of a rhinoplasty, Aufricht's method of crushing that web with scissors or chisel will overcome the difficulty

In the same article, there also appears a complicated and curious explanation for the swelling which occurs along the lines of the osteotomy. The author makes this statement:

"Following a successful narrowing of the dorsum, a hematoma frequently develops around the eyes. The patient should be informed that this hematoma contains not only essential material for the reconstruction but also for protection against infection."

Is this a fact or an alibi? It seems that a more simple explanation for the postoperative swelling in this region is the periostitis which develops from the trauma of the operation. And as a rule, the greater the trauma the more severe the reaction and swelling will be.

In the January, 1947, issue of Medical Economics, Dr. Harry A. Davidson, editor of the Journal of the Medical Society of New Jersey, calls attention to a number of paragraphs culled from various articles, in which the authors employ complicated phrases instead of simple language. He calls them "Medical Gobbledygook"—a very apt description, indeed!

In another article, (7) the artistic point of view in rhinoplasty has been exaggerated and misinterpreted to such a degree that the public is given the false impression that it is within the power of the plastic surgeon to create lines and facial effects such as are seen in the works of the world's most renowned artists. As a matter of fact, the books written by artists for art students have very little bearing on the ability of a surgeon to produce a good cosmetic result. It is well known that there are certain inherent qualities in every human being which enable that individual to attain perfection in certain tasks with much greater facility than the average. This applies in every vocation where craftsmanship is involved, and it is also true of students of art or music; some excel, while the rest remain mediocre or worse.

The artistic anatomy of the face is based on certain accepted proportions and relationships of the component parts which are considered normal, and from which any radical deviation is considered abnormal or unesthetic. Thus, a rhinoplastic surgeon should possess a visual appreciation of line and form, but need not necessarily be able to draw pictures, just as a person may have a great appreciation for music and not be a musician.

Rhinoplasty is "surgical craftsmanship." It, therefore, may be good, bad, or indifferent. Good results depend upon the surgeon's thorough understanding of the anatomy and the functions and relationships of the parts, plus his manual

Its chief function, however, is to form and support the nasal tip. Thus it is much simpler to get a mental picture when one speaks of the lateral cartilage and the alar cartilage, since they can not be confused, as often occurs when one refers to them as the upper lateral cartilage and lower lateral cartilage. Still greater confusion is created when one writer refers to the caudal margin of the upper lateral cartilage as being in contact with the cephalad margin of the lower lateral cartilage. That requires both a diagram and a compass. I believe no one would experience any difficulty if the same relationship of these cartilages were expressed in the language of Joseph: The lower border of the lateral cartilage lies in contact with the upper border of the alar cartilage.

Again, we recently came across this passage in an article on rhinoplasty: (6)

> "There is a small gap between the caudal borders of the upper lateral cartilages where the cartilaginous septum forms a part of the bridge of the nose. In the caudal region of the septal cartilage, i.e., in the region of the lower lateral cartilages the lines of tension extend in the form of a concave curve. When the nasal tip is pressed sagitally against the upper lip, the elastic recoil of the hyperbolic trajectory of the septal cartilage counteracts this movement by restoring the natural position."

We believe the author implies that when the tip of the nose is pressed against the upper lip in the presence of an intact septal cartilage, it will spring back to normal position when the pressure is released.

As an example of faulty conclusion, we wish to quote again from the same well-authenticated article on the anthropological development of the maxilla and cranium, and the transmission of stresses and strains from the jaw to the various parts of the cranium along what are called Beninghoff's lines. We have no quarrel with the main body of the article since it is well documented with references. But the conclusions drawn therefrom, as they apply to modern rhinoplasty, not only are erroneous, but contain the following complicated verbiage

> "The Ventral saw cuts run nearly parallel to Beninghoff's lines of force, but the dorsal cuts cross these lines and split the naso-frontal buttress in its cranial course to the frontal vault."

This leads the author to conclude that a widening of the nasal bridge has a tendency to recur owing to the formation of some mysterious trabeculae which are laid down in the direction of the applied force according to "Wolff's law." He also claims that the use of the jaws in masticating food promotes excessive formation of callus, and that this rapid healing of the parts is detrimental to the final cosmetic result. He therefore forbids his patients to use the incisor and canine teeth to bite off a piece of bread or chew any hard food for at least six weeks.

My own experience, based on several thousand rhinoplasties, does not conform with these conclusions. On the contrary, I permit patients to have solid food twenty-four hours after operation and find them none the worse for it. It is common knowledge that a fracture displacement of the nose, caused by a blow, does not have a tendency to right itself because the patient uses his jaws for

"The purpose of this paper is to challenge contemporary orthodoxy which still adheres to the concept that maintenance of the profile projection of the nasal pyramid is dependent mainly on support furnished by the septum. . . . That under static conditions the septum is merely a redundant member, offering no support whatever. That the saddling of the nose following a submucuous septal resection too near the dorsum and the drooping of the tip, the distortion of the lobule and the asymmetry of the nares following the removal of the caudal end of the septum are not the results of lack of septal support but are due to the development of internal stresses arising from cicatrization of the deskeletonized connective tissue."

That to me, is like saying that a chair with three legs will tip over not because it has a leg missing, but because there is an empty space which permits the forces of gravitation to come into play.

The paper in question is many pages long and an equally long commentary could be written about it. But it is necessary to point out only some of the more amazing statements made in this article. For example, referring to certain works on engineering and the building of gabled roofs and cantilever bridges, the authors go on to prove by means of a mathematical formula that the septum is a superfluous structure which serves no purpose whatever, except possibly to provide patients for rhinologists. They advocate a dangerous procedure when they advise the complete removal of a septum. They say it has no effect on the profile elevation of the nose.

I should like to call the attention of these authors to a simple fact in rhinoplasty. When a person with a prominent nose is to have the prominence reduced to normal, the rhinoplastic surgeon cuts down the bony elevation to the desired level and proceeds to modify the cartilaginous elevation by slicing down the dorsum of the septal cartilage. With each stroke of the scalpel and with each strip that is cut off, the level of the nasal projection is diminished until a normal elevation is attained. It is the septal cartilage which determines the elevation of the nasal pyramid. Not only that, but the length of the nose depends upon the length of the septal cartilage. The shortening of a nose is accomplished by cutting off a wedge at the lower end of the septum and suturing the columella to the remaining portion of septal cartilage. Do these authors still maintain that the septal cartilage is "merely a redundant member"?

As to the mathematical formula by means of which they feel that they have proved the septum to be an unnecessary structure, I am quite certain that in the near future some one will come forth with a more involved formula which will establish the fact that the entire external nose is a superfluous and redundant member. One may even argue that with the advances made in the field of prosthetics, an individual might own a selection of latex noses which could be worn to fit special occasions or moods.

Another matter of technical procedure which these authors advocate, and with which I do not agree as a result of extensive personal experience, is the introduction of a strip of cartilage into a space created between the columellar extensions of the alar cartilages after complete removal of the septum. Since this strip of cartilage has no fixed point of attachment, it will not prevent retraction. They

dexterity in modifying the form of these structures without interfering with their normal function and relationships.

This then, leads me to point out the fallacy of drawing lines and angles on a photograph of the patient—a sort of "blue print"—to denote the type of nose the surgeon intends to create. Nothing is further from the truth than such chicanery. It is not only impossible of accomplishment, but a dangerous procedure from a medical-legal standpoint. A patient armed with such a 'blue print", and a surgical result that bears no resemblance to it, might possess evidence of failure to fulfil a contract. The article in question uses fig. 14 as an illustration of how a face may be "charted." It appears to have been completely "blue printed" for the perfect nose for that particular face. Fig. 15 shows the final result, which in my opinion not only fails to comply with the general accepted standards of esthetics, but in addition bears no relationship to the geometric "blue prints" in fig. 14.

Going one step further, another author (8) suggests a procedure that is even more improbable of accomplishment and is bound to result in still more profound disappointment for the patient. He suggests that,

"The patient's photograph should be printed on thin paper so that its transparency will not be interfered with when the picture is held up to the light. A pencil sketch is then made as the photograph is held on an X-Ray shadow box. The original profile is lightly traced on to the back of the photograph and then a new profile line is drawn over this tracing. After several such sketches, one can determine the profile best suited to the face under consideration. The new profile decided upon is then pencilled in a heavier line than the original sketch of the deformity."

My only comment on such wishful thinking is that it is the height of optimism, unless one were to characterize it as misrepresentation.

The literature on rhinoplasty has become so voluminous that it is not possible to take up each article individually. I am, however, particularly concerned with the attempt of a group of men to create a synthetic literature. Their writings, which are finding their way into medical journals, are constantly growing more complicated in their verbiage, more faulty in their conclusions, and more dangerous in their teachings. Fortunately, I have heard many men interested in this work express the opinion that much confusion could be eliminated by a more rigid editorial policy on the part of some medical journals.

One wonders what has become of the anterior and posterior parts of the body, or the upper and lower margin of a structure. As they apply to nasal anatomy, they have become, in this synthetic literature, caudad and cephalad and ventral and dorsal—also cephalo-dorsal or ventro-caudad or any other combination, so long as it is guaranteed to bring about an attack of vertigo. I have discovered further, in trying to keep up with this literature, that the dorsal part of the septum is in the ventral part of the nose, and the ventral edge of the septum forms the dorsum of the nose, or is it vice versa?

In a paper published in Archives of Otolaryngology a group of four authors (9) start out by saying:

4. Ersner, Matthew M.D., Annals of Otology, Rhinology and Laryngology, Vol. 53, No. 3, pp. 552. "Nasal Injury in Dystocia."
5. Proetz, Arthur W. M.D., Arch of Otolarnygology, Vol. 39, pp. 514–517, June, 1944. "Physiology of the Nose from the Standpoint of the Plastic Surgeon."
6. Griesman, Bruno M.D., Arch of Otolaryngology, Vol. 42, pp. 117–122, August, 1945. "Structure of the External Nose."
7. Daley, Jacob M.D., Arch of Otolaryngology, Vol. 42, pp. 33–41, July, 1945. "Introduction of an Artistic Point of View in Regard to Rhinoplastic Diagnosis."
8. Becker, Oscar J. M.D., Annals of Otology-Rhinology and Laryngology, Vol. LV. No. 3, pp. 562–571, September, 1946.
9. Fomon, Samuel M.D., et al, Archives of Otolaryngology, Vol. 44, No. 2, pp. 141–156. "Plastic Repair of the Deflected Nasal Septum."

say it is used merely as a batten. Batten may work in the hold of ships to secure cargo where it has a fixed point of support, but it is useless for the purpose suggested.

As a general rule it is best to avoid implants, grafts, and transplants when contiguous tissues can be utilized in any correction. This fáct was forcibly impressed upon me by Ferris Smith when I heard him discuss a paper read before the Society of Plastic and Reconstructive Surgery. This article dealt with various types of grafts used in facial injuries which, according to Smith, would have fared much better had contiguous structures been utilized in the corrections.

In this short review of rhinoplastic literature, I have tried to point out how much space and time have been utilized by irrelevant "tie ins" with art, mathematics, anthropology, obstetrics, and engineering. Moreover, I have endeavored to show that the many complicated new names for anatomical structures which have been created, or the obsolete names which have been revived, offer not a single improvement upon the well-founded technique devised by Jacques Joseph; in fact, they make one wonder whether articles advocating their usage are designed to benefit the reader or the author.

In conclusion, I wish to urge every serious-minded young man who intends to specialize in this branch of plastic surgery to learn to distinguish between that which is essential to the performance of his duty to his patient, and that which is done too frequently either to "glamourize" the surgeon or confuse the spectator. The mounting of "blue printed" photographs in the operating room is one glamour device. The setting up of casts on an easel in imitation of a landscape artist is another. Neither serves any useful purpose. Photographs and casts are helpful only as records for future reference. Neither drawings, photos, nor casts have any influence on the outcome of a rhinoplasty. The essential elements consist of the surgeon's good judgment and his esthetic appreciation, plus his ability to produce the best possible result from the material at hand.

I have always impressed the following facts upon the many younger men whom I have had the good fortune to train:

1. Have a good mental picture of the anatomical structure of the nose.
2. Know the normal form of each component part and its relation to every other part.
3. Look upon every cosmetic defect as either an enlargment, an underdevelopment, or a disturbance of the normal relationship of the various structures.
4. Decide what structural changes are necessary to bring about esthetic normalcy.
5. Practice the various steps of a complete rhinoplasty and perfect yourself by performing only one or two of the steps at a time under the supervision of a trained surgeon.
6. If you possess good judgment, manual dexterity, and a proper appreciation of what constitutes good esthetic form, your results will be very gratifying.

1. Griesman, Bruno M. D., Arch of Otolaryngology, Vol. 39, pp. 334–341. April, 1944. "Muscles and Cartilages of the Nose from the Standpoint of a Typical Rhinoplasty."
2. Safian, Joseph M.D., American Journal of Surgery, Vol. L. No. 2, pp. 274–280, November, 1940. "Failures in Rhinoplastic Surgery."
3. Ersner, Matthew M.D., Pennsylvania Medical Journal, March, 1946. "Nasal Injuries and their Implications."

The first tube measured 14 x 7 cm. After two weeks a similar tube was raised separated from the lower end of the first by 4 cm. Two weeks later the intervening bridge of skin was also elevated and tubed. The single long tube was then permitted to stabilize for two months (fig. 3).

Second stage. The tube was migrated to the anterior upper thoracic wall in two steps. The lower abdominal end was first detached and implanted tan-

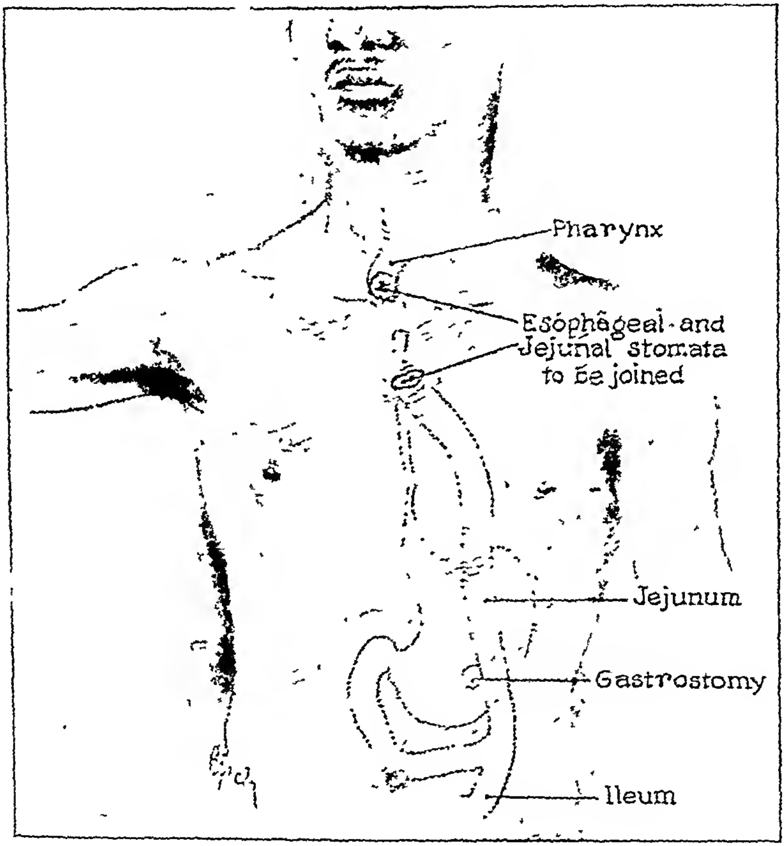

FIG 1

gentially in the right infraclavicular fossa (fig. 4). After two weeks the upper thoracic end was detached, opened and implanted transversely between the two fistulae (fig. 5) Here it was permitted to rest for two months.

Third stage A skin lined esophagus was formed which connected the fistulae and was covered by the remainder of the migrated tube flap. The flaps which when raised and turned inward to form the esophagus were made from an incision

THE USE OF A MIGRATED SKIN FLAP FOR BOTH LINING AND COVERING OF AN ARTIFICIAL ANTETHORACIC ESOPHAGUS

EDWARD M. HANRAHAN, M.D.

Baltimore, Md.

The use of a migrated flap of skin and subcutaneous tissue to cover an antethoracic esophagus constructed of local skin was first reported by Davis and Stafford (1) in 1942. In their case the esophagus itself was formed by the usual method of utilizing anterior thoracic skin between the sternal notch and the costal margin and this tube was then connected with the stomach by a short segment of jejunum. Because of his desire to avoid distortion of the breasts in his patient, a sixteen year old girl, an inevitable consequence of undermining, advancing and closing the defect by suture, Dr. Davis decided to cover that area by tubed flaps migrated from the lateral thoraco-abdominal wall. This had the further advantage of being a more stable covering, more assured in its healing than a free graft would be and could be applied with complete absence of the tension inevitably associated with undermining and advancing the adjacent margins. This method was also advocated by Ladd (2) in 1944.

Esophageal surgery in recent years has been marked by increasing use of the jejunum so freely mobilized as to be drawn through an antethoracic subcutaneous tunnel as high as the clavicles and there anastomosed with the esophagus (Yudin (3), Longmire and Ravitch (4)), or the anastomosis may be done high in the thorax (Rienhoff (5)). In these circumstances the need for a skin esophagus is eliminated. Free jejunal mobilization depends on a sufficiently long mesentery, an abundance of vessels and a proper selection of the points of ligation that will preserve the large first branch of the mesenteric artery to the jejunum, as advocated by Rienhoff.

Impairment of the jejunal circulation may result in spite of all precautions, either at the time of operation or shortly afterward. In one instance Longmire felt that he had successfully avoided necrosis of the upper end of the jejunal segment by immediate suture of the mesenteric vessels in that portion with the internal mammary vessels. In another case the jejuno-esophageal suture was completed antethoracically by Rienhoff but subsequent necrosis of several centimeters of the upper end of the jejunum necessitated its removal. This resulted in esophageal and jejunal fistulae separated by eight cm. of skin which because of scarring was unsuitable for use as a connecting tube. It is this case which called for the migration to that region of skin which could be used for both lining and covering of the dermal portion of the antethoracic esophagus.

The anatomical conditions present at the time that the reconstruction was started are shown in fig. 1. The esophageal and jejunal fistulae with adjacent scarred skin are shown in fig. 2. The stages of the reconstruction are as follows:

First stage. A tubed flap of skin measuring 32 x 7 cm. was raised in the right lateral thoraco-abdominal region in three steps, as described by Webster (6).

The first tube measured 14 x 7 cm. After two weeks a similar tube was raised separated from the lower end of the first by 4 cm. Two weeks later the intervening bridge of skin was also elevated and tubed. The single long tube was then permitted to stabilize for two months (fig. 3).

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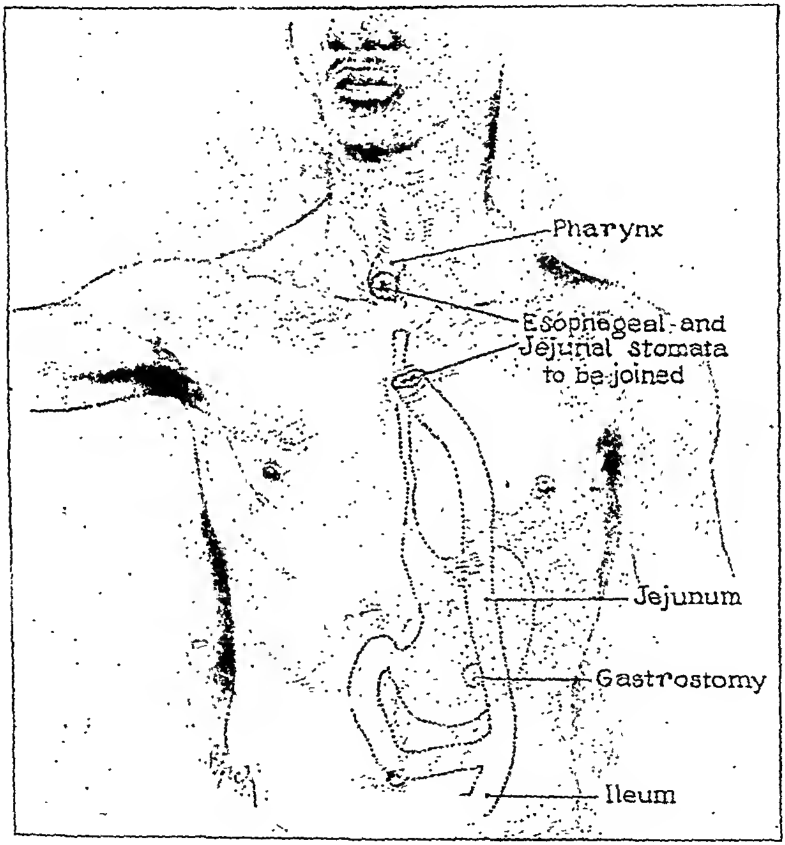

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Fig. 4

Fig. 5

Fig. 2

Fig 3

Fig 7

Fig 8

roughly a parallelogram in shape with rounded corners (fig. 6). The closure was accordingly a continuous s-shaped curved line with no sharp angles except at its extremities. The exposed subcutaneous tissue was then covered by the

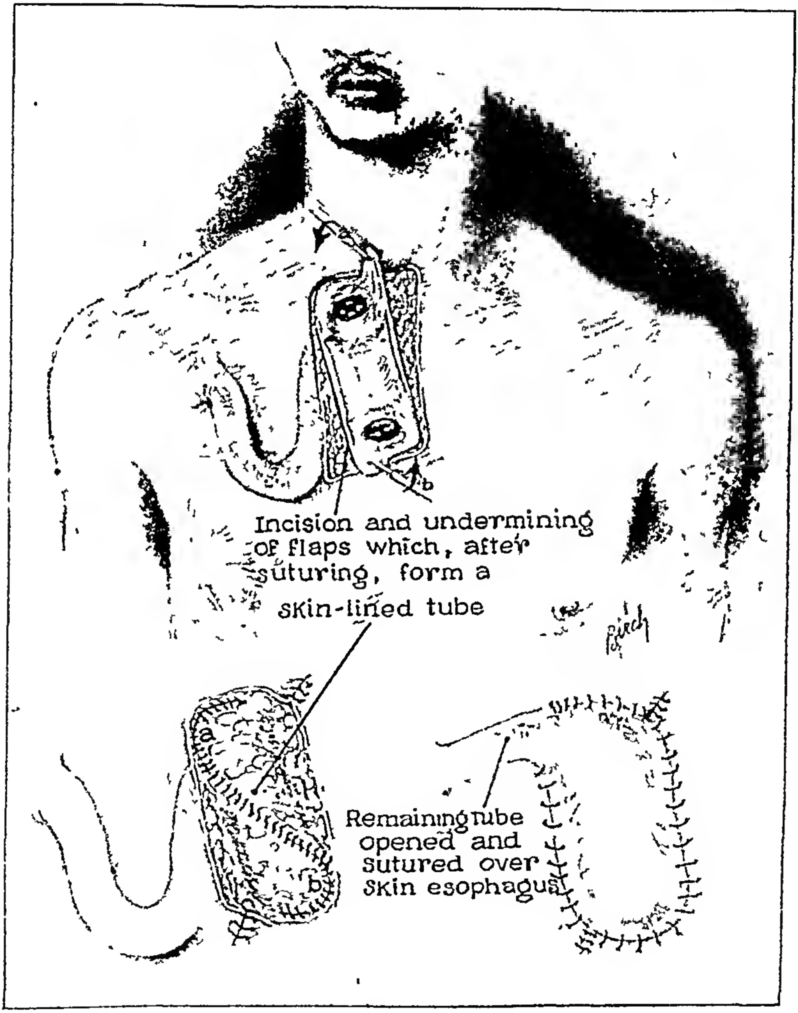

Fig 6

opened remainder of the migrated skin tube after reducing it in size by suture of the two narrow angled corners After two weeks the tube was divided and the suture of the covering flap completed. As a precautionary measure the small remainder of the original tube was conserved and reimplanted near the shoulder

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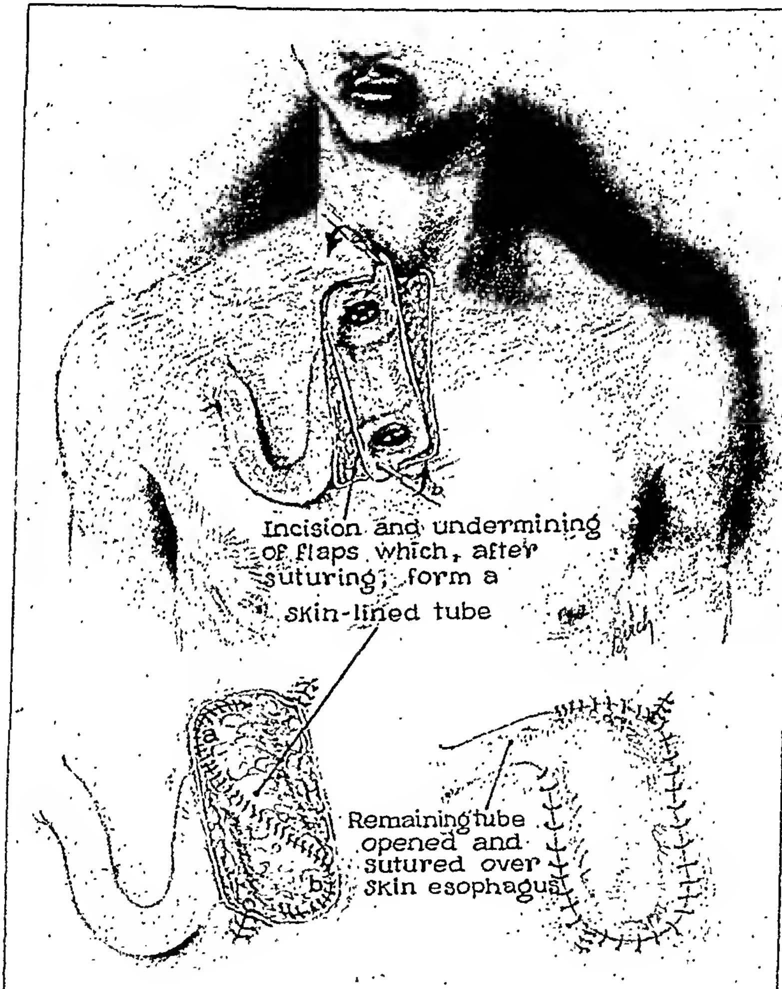

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FIG. 7

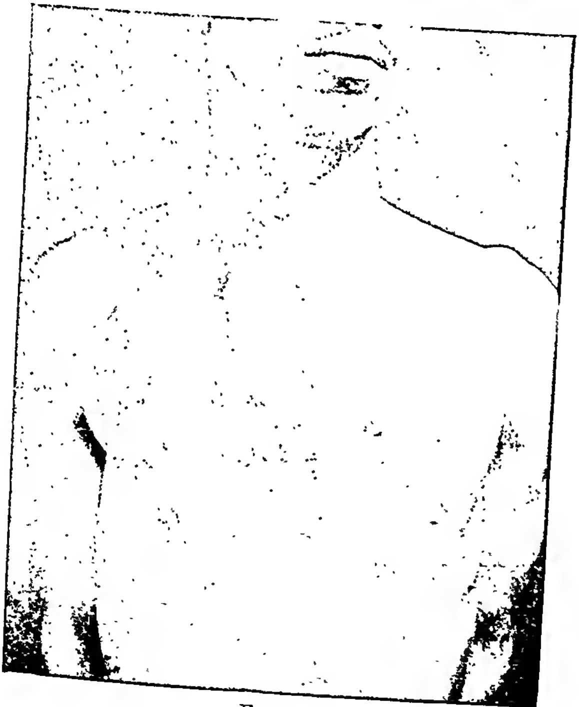

FIG. 8

(fig. 7). When it was certain that no further tissue would be needed it was removed (fig. 8). Two small points of leakage developed. One closed spontaneously, while the second healed after freshening and suture of its edges.

This skin esophagus functions very satisfactorily. The patient has learned to avoid heavy meats and coarse vegetables and is able to swallow anything he wishes except ice cream or ice water. The latter initiates too much jejunal motility. It is our plan now to connect his lower jejunum with the stomach so that the latter, now secreting pure gastric juice, will not be by-passed.

Ordinarily the procedure described above need not be utilized in the construction of an antethoracic esophagus. However when the situation is complicated by scarred or otherwise unusable skin it offers a satisfactory solution of the problem.

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THE PROBLEM OF THE PROTRUDING EAR

WILLIAM G. McEVITT, M.D.[1]

Detroit, Mich.

Of all doctors, the plastic surgeon is perhaps most familiar with mans' inhumanity to man. For the blind and for the lame there is pity and helpfulness. For the deformed and disfigured there is too often mockery and derisive laughter. No deformity is exempt but the congenitally deformed are made to suffer more than the victim of trauma or disease. The latter is obviously the victim of an evil external influence and therefore is given a modicum of compassion. To the unthinking, however, the congenitally deformed are by implication treated as blameworthy and the fair objects of criticism and taunts. Every member of the profession has seen many serious consequences of this attitude.

Protruding ears are one of the most common of congenital deformities. They are very obvious, cannot be hidden and are a prime target for the cruel humor of the multitude. Even perfect strangers do not hesitate to add their bit to the misery of the victim. Lop-ears, sail-ears, jug-ears and donkey-ears, are some of the witticisms used. The more imaginative tormentors refer to the individual as about to take off, as like unto a taxicab with open doors, as "Dumboesque" after the famous Disney elephant and so on ad infinitum and ad nauseam.

When confronted with one of these sufferers, the surgeon must have a thorough knowledge of the normal ear. A normal ear is shown in fig. 1. It is the most intricately and delicately formed external bodily part and is so complex that even the most experienced have to refresh their memory of its contours again and again. Like all anatomical models the ear shown is a composite. In the living body many small variations and proportions occur which are normal and appropriate for a particular individual.

Congenital ear deformities can be classified as follows:

1. Protruding ears
2. Microtia
3. Macrotia
4. Miscellaneous abnormalities in shape such as pointed ears.

Of all such deformities protruding ears are by far the most common. Examples of all other types of ear deformity are seen only occasionally. A frequent mistake of the laity and even of the profession is to refer to these ears as lop-ears. Lop means to hang limply and the protruding ear certainly does not hang and is anything but limp.

The protruding ear is a true deformity. The usual description of its development is that during the sixth week of fetal life, six tubercles appear on the mandibular and hyoid arches around the first cleft depression and also from the elevation of the skin behind the tubercles on the hyoid arch. The tubercles are

[1] From the Straith Clinic for Plastic Surgery.

arranged in two parallel groups of three with the skin fold above and behind the topmost tubercle of the posterior group. The helix grows from the upper tubercle of the anterior group and the skin fold. The crus of the helix arises from the middle tubercle of the anterior group and from the lower anterior tubercle the

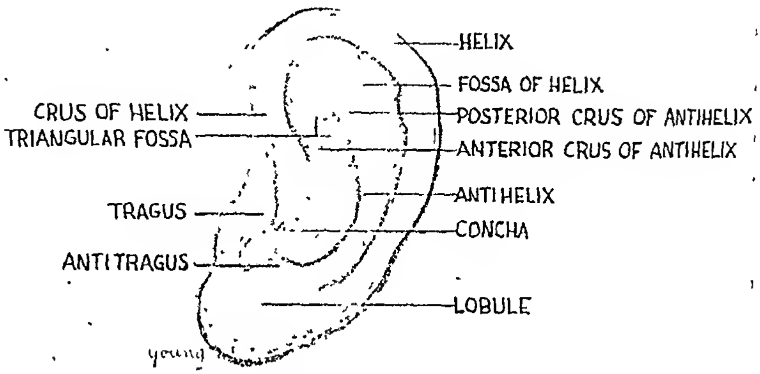

Fig 1. Composite Drawing of Normal Ear

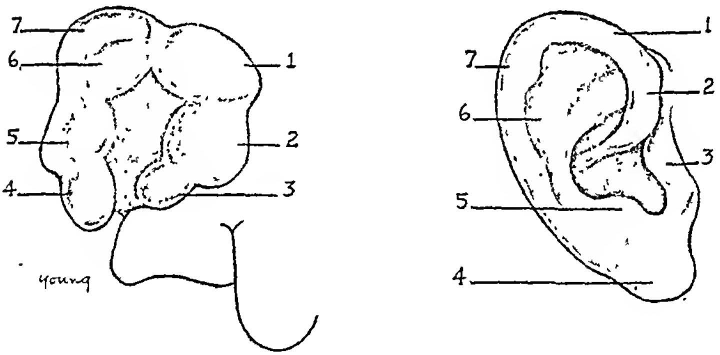

Fig 2 Embryology of the Ear

1, 2, 3, anterior row of tuberules from the mandibular arch forming respectively the helix, crus of the helix, and tragus 4, 5, 6, posterior row of tubercles from the hyoid arch forming respectively the lobule, antitragus and antihelix. 7, skin elevation from which the descending helix develops (Adapted from Davis and Kitlowski.)

tragus develops. The middle posterior tuberele produces the antitragus and the lower posterior tubercle the lobule (fig. 2).

During the third month of fetal life the helix grows rapidly so that it projects forward and covers the still undeveloped antihelix. At this stage protrusion is normal. When the antihelix does not develop normally, the helix continues to

overhang and protrusion persists. In the extreme case no antihelix is visible so that protrusion is maximum and the concha and fossae form one large concavity. The deformity is hereditary. Potter (1) studied five generations of family groups. In these families the malformation was due to a single dominant gene. It was regular in expression and regular in transmission to half the children when marriage of abnormal to normal individuals occurred. There was no transmission by normal members of the family.

At birth the components of the ear are completely formed and the ear rests at an angle of about 30° to the head. The entire ear grows with the body until about seven or eight years after which there is very little growth. Brown (2)

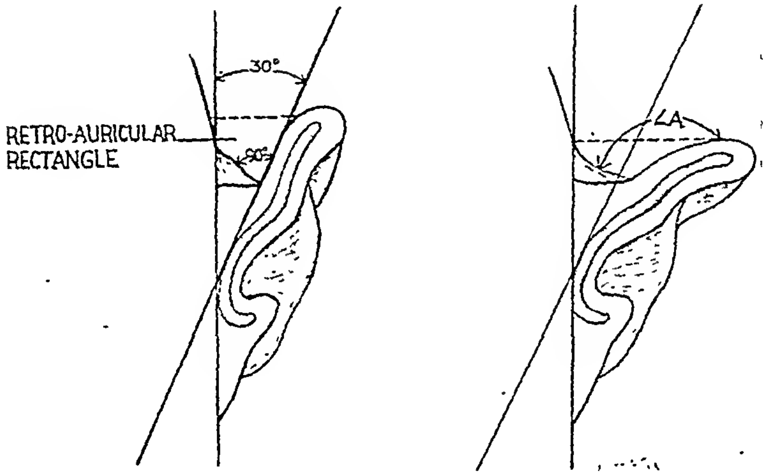

FIG. 3. DRAWING OF HORIZONTAL SECTIONS OF NORMAL AND PROTRUDING EARS VIEWED FROM ABOVE

The normal retroauricular space is an irregular rectangle The body of the protruding ear maintains the same angle of 30 with the head as does the normal ear, but the angle formed by the juncture of the scapha and concha is much greater than the normal of about 90.

compared the ears of parents and their children of school age in some hundreds of cases and found very little difference in the size of the ears. The angle of 30° at which the normal ear is said to be attached to the head has been the cause of misunderstanding and consequently of incorrectly conceived surgical procedures for the correction of protruding ears. It is true that the auricle as a whole is normally attached to the head at an angle of 30° but since its attachment is very broad, the retro auricular space is not triangular in outline but irregularly rectangular. The boundaries of this rectangle are anteriorly the wall of the concha coming off the head at approximately 90°. Laterally the scapha forming an angle of 90° to 120° with the concha, medially the mastoid area and posteriorly an imaginary line from the helix to the mastoid (fig. 3).

arranged in two parallel groups of three with the skin fold above and behind the topmost tubercle of the posterior group. The helix grows from the upper tubercle of the anterior group and the skin fold. The crus of the helix arises from the middle tubercle of the anterior group and from the lower anterior tubercle the

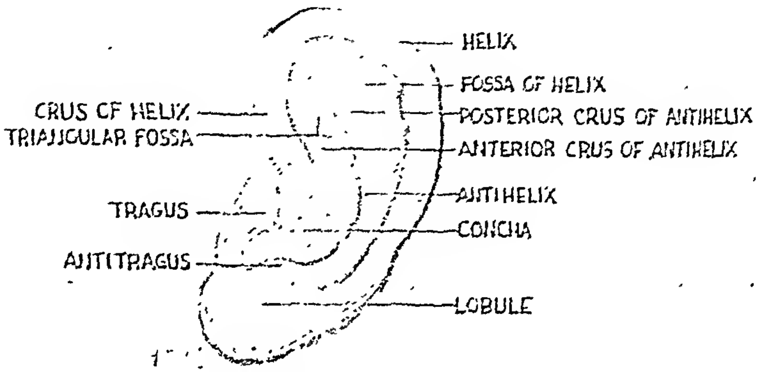

FIG. 1. COMPOSITE DRAWING OF NORMAL EAR

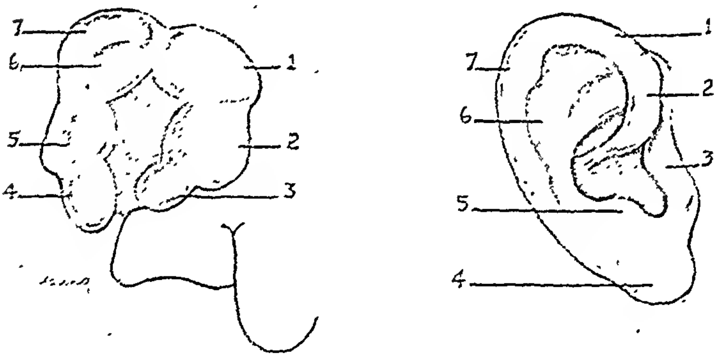

FIG. 2. EMBRYOLOGY OF THE EAR

1, 2, 3, anterior row of tubercles from the mandibular arch forming respectively the helix, crus of the helix, and tragus 4, 5, 6, posterior row of tubercles from the hyoid arch forming respectively the lobule, antitragus and antihelix 7, skin elevation from which the descending helix develops (Adapted from Davis and Kitlowski.)

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During the third month of fetal life the helix grows rapidly so that it projects forward and covers the still undeveloped antihelix. At this stage protrusion is normal. When the antihelix does not develop normally, the helix continues to

that the suffering of the patient does not necessarily vary directly with the degree of protrusion. Most ears are normal in size for the individual concerned but some patients present ears which are unusually large. Inequality of protrusion on the two sides is common. With rare exceptions the subject can be classified in one of the following types:

1. Ears of normal size for the subject with moderate protrusion caused by underdevelopment of the normal fold of the antihelix. The concha and fossae are of approximately normal size and their ratio to one another is correct. The antitragus is not overprominent (fig. 8).

2. Large ears usually with marked protrusion, underdevelopment of the fold

Fig. 6 Fig. 7

Fig. 6. Protrusion Combined with Macrotia and Displacement
Fig. 7. Protrusion Combined with Microtia Curling, Displacement, and Facial Asymmetry

of the antihelix, overprominence of the antitragus and wide scapha (fossa of the helix) (fig. 9).

3. Long narrow ears with little or no evidence of the antihelix. The structure seems curled forward. The concha and fossae form a continuous hollow giving the ear almost the appearance of a shell. They tend to be wide at the top and taper toward the lobule being roughly triangular (fig. 10).

Any of the above types may be unilateral or bilateral and may be found in individuals with one or more of the other deformities already mentioned. It is the writer's observation that unilateral protrusion is seen most commonly in Type 2, occasionally in Type 1, and rarely in Type 3. Associated deformity is found most frequently in unilateral examples of Type 2.

The angle formed by the scapha and concha is governed by the fold of the antihelix. If this structure has failed to develop normally, the scapho-conchal angle becomes larger so that in extreme cases of protrusion it is almost entirely obliterated. The relationship of the concha to the mastoid remains at about 90°. Despite references in the literature, the writer has never seen a case where this was not true. The rational approach therefore is to correct the deformed antihelix. This automatically reduces the scapho-conchal angle to normal and corrects the protrusion but maintains the normality of the retro-auricular space. Attempts to move the entire ear closer to the head on the theory that the whole structure is protruding mutilate the concha and convert the retro auricular

FIG. 4

FIG. 5

FIG 4 UNILATERAL PROTRUSION
FIG. 5. PROTRUSION COMBINED WITH MICROTIA AND DISPLACEMENT

rectangle into a narrow triangular slit which not only appears abnormal, but is often a source of irritation and infection.

Protrusion may be unilateral (fig. 4) or bilateral. It may be associated with other congenital deformity such as reduplicated Darwinian tubercle, absence of lobule, microtia of any degree, macrotia, curling or displacement (figs. 5 and 6). It is sometimes seen in association with marked facial asymmetry (fig. 7). In this case the deformed ear is on the same side of the head as the malformed half of the face. However, the great majority of cases are bilateral and unaccompanied by other abnormalities.

The protrusion varies from very slight to extreme and one can say in passing

GROUP ONE

Methods designed to bring the entire ear closer to the head:

1. Excision of an ellipse of skin from the cephalo-auricular angle with simple closure (Pearl & Monks (3)).

2. Excision of an ellipse of skin from the cephalo-auricular angle with dissection of the auricular cartilage from the skull followed by tight suturing of the cartilage to the deep fascia over the mastoid (Miller 1924 (4)).

3. Excision of skin over the mastoid after which a flap of post auricular skin is raised, pulled back and sutured over the raw area on the mastoid (Ruttin (5)).

4. Excision of triangles of cartilage through a transverse incision in the cartilage made close to mastoid (Eitner (6)).

5. Longitudinal incision in cartilage adjacent to mastoid with overlapping of the edges (Alexander (7)).

A B C

FIG. 10. A, B, C, EXAMPLES OF TYPE THREE PROTRUSION

6. Excision of longitudinal strips of cartilage crisscrossed with some transverse excisions. The weakened cartilage is then sutured to mastoid (Gersuny (8)).

7. Formation of a flap of auricular cartilage which is turned back and anchored under a bridge of periosteum over the mastoid process (Payr (9)).

8. Anchorage of the posterior surface of the auricle with a strip of fascia lata (Ruttin (5)).

9. Excision of an elliptical segment of skin at the auricular mastoid angle followed by excision of a longitudinal section of cartilage in the same area the ends of the excised piece being wider than the central portion (Morestin (10)), fig. 11.

GROUP TWO

Methods designed to produce a normal antihelix and preserve the essentially normal contours of the other parts:

1. Excision of a strip of skin and cartilage on the posterior surface of the aur-

Since the earliest conception of the protruding ear was that it stood out directly from the skull, it is natural that the first attempts at correction attempted to pull the entire ear close to the head. When the true nature of the deformity was realized an entirely different approach developed. We may then divide correction methods into two groups, the first of which is of historical interest

A B C

FIG. 8. A, B, C, EXAMPLES OF VARIOUS DEGREES OF TYPE ONE PROTRUSION

A B C

FIG 9 A, B, C, EXAMPLES OF TYPE TWO PROTRUSION

only. These methods are classified below according to their embryological and anatomical features and will hereafter be referred to in these terms. Where known the originator's name is mentioned but the operative procedures will not be described thusly in the discussion because it is the writer's experience that this leads to endless confusion in the mind of the reader.

taunts were in use as in the United States today. This operation is still being done and as recently as 1941, Cox (17) defended it on the ground that it set the ears back well and satisfied the patient.

All of these operations had the common fault that the ear is conceived as standing straight out from the skull. We know that this is not the case. The abnormality of the antihelix with its failure to fold and consequent reversion is the principal defect. This seems a very simple observation. If one pushes backward against the helix of the average protruding ear, it is easily forced into a very normal appearance and invariably it will bend back along the antihelix not at the cephalo-auricular angle. It seems obvious but like most scientific obser-

A B C

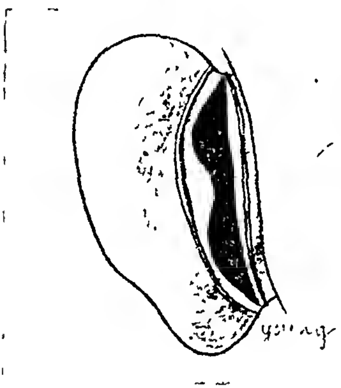
FIG. 13. A, B, C, AUTHOR'S CASE DONE BY EXCISION OF CARTILAGE AT CEPHALO-AURICULAR ANGLE

Note the "plastering" of ears to the head and abnormal configurations in the lateral view. Most cases are even more distorted. Oddly enough the patient wishes the ears could be even closer to the head.

vations it became obvious to the profession when it was pointed out. This Luckett did in 1910.

Except for the operations in the first group which have been obsolete for years, the writer has tried all of these procedures and has found merit in most of them. Morestin's excision of the cartilage at the cephalo-auricular angle unquestionably sets the ear close to the head in types one and two but has many objectionable features. The ear is plastered against the head which is not normally the case. There is no antihelix fold and thus the whole body of the ear is close to the head. This destroys the normal retroauricular rectangle which sometimes makes cleansing difficult and has been known to give rise to friction irritation of the skin. The test of a protruding ear operation is the lateral view and this operation here makes a poor showing. The skin of the concha is wrinkled and many abnormal folds appear principally one caused by the cut edge of the cartilage showing through the skin (fig. 13). In Type Three ears the operation is very

icle along the line of the antihelix. The edges of the cartilage are then everted using a Lembert type of suture this forming an antihelix ridge on the anterior surface. (Luckett 1910 (11)) fig. 12. This operation is really the only member of its group though it has been repeated with minor changes by numerous surgeons. Davis and Kitlowski 1937 (12) removed cartilage in the same way but used an incision at the cephalo-auricular angle. Barsky 1938 (13) bevelled the incision in the cartilage so that when brought together they would form a sharper edge to the antihelix. New and Erich 1940 (14), added the excision of an additional small strip of cartilage to form the posterior crus of the antihelix. Baxter



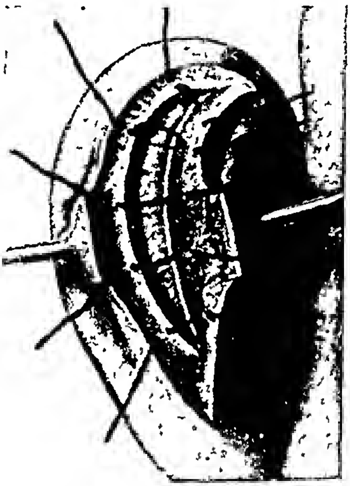


Fig 11 Fig 12

Fig 11 Drawing of Morestin's Excision of Ellipse of Skin and Cartilage from the Cephalo-auricular Angle

This shows the modification of making the cartilage excision more extensive at each end. Morestin's original article showed a simple elliptical excision

Fig. 12. Luckett's Original Illustration showing the Excision of Cartilage Along the Predetermined Site of the Antihelix with Sutures in Place

When tied, these sutures cause the cut edges to unite and form a ridge All modern operations are based on this fundamental procedure (By permission of Surgery, Gynecology, and Obstetrics)

1941 (15), used stainless steel wire to hold the everted edges in position. Young 1945 (16), after removing the strip of cartilage used no sutures in the cartilage and allowed the posterior margin of cartilage to slide behind the anterior margin.

The operative procedures listed under group one are or should be of purely historic interest. Most of them are unnecessarily complicated. The simplest one of the group is the excision of a long strip of cartilage wide on the ends from the cephalo-auricular angle. This is also the best. Morestin's description of it is a very well presented article and incidentally his experiences with nineteenth century French children shows us that the world has not changed. The same

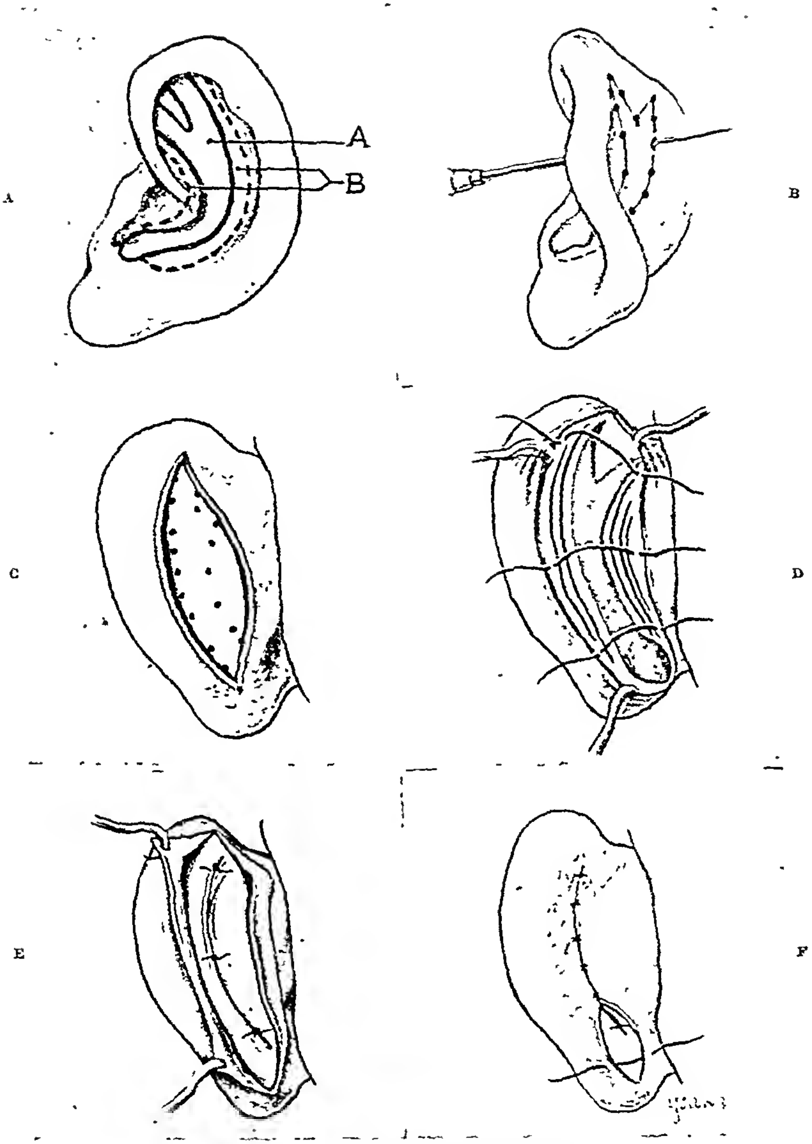


FIG. 14. AUTHOR'S METHOD OF PROCEDURE

a. (A) Limit of antihelix excision drawn on anterior surface.
   (B) Limit of incisional weakening.
b. Transfer of outline to posterior surface by method of Davis and Kitlowski.
c. Ellipse of skin excised showing needle marks on underlying cartilage.
d. Excision of cartilage along antihelix line with projection for posterior crus, wide inferior excision in antitragus, parallel weakening incision, and three sutures in position.
e. Sutures tied forming antihelix.
f. Closure of skin with interrupted silk sutures.

unsatisfactory. These shell-like ears are simply forced in closer to the head but the shell remains cupped forward and is essentially abnormal in appearance in all views. The claim of Cox that the operation satisfies most patients should not be the criterion of the plastic surgeon. However, the writer has heard many complaints about the results of this procedure. Old habits die slowly so this operation will probably be done for years to come. A final objection is that secondary correction in these cases is well nigh impossible.

Luckett's introduction of a new approach to the protruding ear problem greatly improved results. Any of the various operations based on this fundamental concept produce acceptable ears. It has been the writer's experience that no one method is universally applicable to all cases. Generally speaking the use of mattress sutures, Lembert sutures, gauze bolsters and special materials such as steel wire seems unnecessary if the cartilage of the ear has been adequately weakened and adjusted. Type One ears are ideal subjects as they are normal in size and deformed only in the neighborhood of the antihelix. Type Two ears require as a rule more excision of cartilage in the antihelix area. They are most likely to require additional excision in the area of the posterior crus. A common abnormality in this type is an overprominent antitragus. Failure to adjust this results in a protruding spine in this area in the finished product. Type Three ears are the most difficult with which to deal as the shell-like auricle may be almost devoid of normal landmarks and have a continuous curving sweep from the cavum conchae to the helix. This type requires careful drawing of the structures and weakening of the cartilage in appropriate areas. It is often best to remove little or no cartilage from these cases. Some form of fixation is usually best as after the non-suture method the cut edges of cartilage may simply overlap.

Fig. 14 illustrates the writer's approach to the problem.

The type of ear having been determined, the area is blocked off with novocaine and the desired contours are outlined on the anterior surface with methylene blue. It is helpful to push the ear backward into normal position by making pressure on the helix. It is thus easier to determine the desired width of the antihelix and the desired steepness of the descent into the adjacent fossae. If excision of cartilage seems indicated the limits of excision are marked. If further weakening is planned its extent is also marked. These markings are then transferred to the posterior surface by piercing the cartilage with a needle at intervals along the marking and touching the needle with methylene blue before withdrawing after the manner of Davis and Kitlowski (12).

Now the ear cartilage is exposed by excising an ellipse of skin on the posterior surface along the predetermined antihelix line. Excision and incision alone or in combination is done as indicated. As time goes on the writer has tended to remove less and less cartilage often removing none. In the last analysis experience alone will teach one what is best in each case. In general type One requires simply incisional weakening or slight excision along the antihelix.

Type Two usually requires considerable excision of cartilage with parallel incisions for weakening. In most cases the posterior crus area should be simi-

A B

Fig. 16, A, B, Type Two Ears Corrected by Excision, Incision, and Suturing

A B

Fig. 17, A, B, Type Three Ears Corrected by Excision, Incision, and Suturing

larly treated. The cartilage removal should extend well down into the antitragus and in addition the remaining antitragal cartilage should be thoroughly cross-hatched with the knife. If this is not done protrusion of the antitragus or the entire inferior extremity of the ear will unbalance the final result.

Type Three always requires marked weakening and sometimes excision of

FIG 15, A, B, C, D, E, MODERATE EXAMPLES OF TYPE ONE EARS CORRECTED BY EXCISION OF CARTILAGE WITHOUT SUTURING NOTE PRESERVATION OF POSTERIOR RECTANGLE AND NORMAL CONTOURS IN LATERAL VIEW

cartilage in all directions. It is the type most likely to require suturing Suturing is always necessary if no cartilage is removed. Otherwise it is optional. Young has published some beautiful results of cases done without suturing. Type One ears are the best candidates for non-suturing. In the larger Type Two ears nonsuturing may result in the antihelix edge being very sharp and prominent.

A B

FIG 16, A, B, TYPE TWO EARS CORRECTED BY EXCISION, INCISION, AND SUTURING

A B

FIG 17 A B, TYPE THREE EARS CORRECTED BY EXCISION, INCISION, AND SUTURING

A B

Fig 18, A, B, Type Three Ears Corrected by Excision Without Suturing

For perfection a secondary correction should be done at the upper pole of the left ear. The patient is satisfied and does not wish it done.

A B

Fig. 19, A, B, Lateral View of Type Three Ear Done by Incisional Weakening and Suturing with no Excision of Cartilage

This is not a serious defect but we are striving for perfection and the normal ear has a gradual fall from the height of the antihelix to the depth of the scapha.

The writer usually uses sutures, one in the center and one near each end of the antihelix fold. A bite is taken on each side beyond the furthest point of excision or incision and the white silk tied. The weakened intervening area mounds up forming the appropriate antihelix fold on the anterior surface. The skin incision is then closed with a row of interrupted black silk sutures. In the past occlusive pressure dressing has been recommended for periods of ten days to several weeks. The writer has found no advantage to this. The ears are dressed with a strip of vaseline gauze over the incision and on all of the crevices of the anterior surface. The whole is overlaid with cotton and gauze and a turban applied to the head. The turban is removed in four days and a light gauze dressing held with adhesive substituted. All dressings are removed in one week and sutures by the tenth day after which the patient is permitted to wash the ears gently.

Serious complications are almost unknown. The excellent blood supply of the ear insures against gangrene and serious infection. A small hematoma is easily expressed at the first dressing but even this is uncommon. Secondary correction is the exception. If indicated it is usually the result of error in the estimation of cartilage removal. For some reason it is more common at the upper pole of the ear. A small incision and adjustment suffices in most cases.

Using these methods excellent results should be obtained in almost every case and the most extreme cases should be markedly improved. There is no reason today why a human should suffer because of protruding ears. The operation causes little discomfort and very little after pain. These cases should be among the most satisfactory that the plastic surgeon does. The patients should be among the most grateful and they are.

SUMMARY

The anatomy, embryology and etiology of protruding ears are reviewed.

A classification of protruding ears is offered.

Various correction methods are listed and evaluated.

The procedure used by the writer is described and its application to the common types is discussed.

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NASAL AND AURICULAR FISTULAE*

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Fistulae of the dorsum nasi offer an interesting surgical problem which can be solved only if the development of the deformity is understood. The following case deserves attention because it presented an interesting finding at operation and because the brother of the patient suffered from auricular fistulae.

CASE REPORT

M. H., age 14, white, female, has a small tumor at the nasal dorsum since birth which became actively inflamed during the first year of life (11 months old) requiring an incision.

When she was seen for the first time at the Research and Educational hospitals, there was a considerable saddle at the junction of the osseous and cartilaginous dorsum nasi. At the bottom of the saddle there was a fistula, the size of a pin-head, brown in color (fig. 1). The fistula was close to the midline and surrounded by normal skin. At the inferior portion of the left nasal bone there was another fistula, larger in size and surrounded by scarred skin (fig. 1). Both fistulae were connected by a subcutaneous channel. There was no pathology inside of the nose. On X-ray film, the arch of the nose was not completely closed due to a defect in the left part of the piriform aperature. The defect was apparently filled by cartilage which originated from the septum cartilage and formed a channel-like structure.

On May 25, 1946 an operation was performed in local anesthesia. An incision was made in the midline of the nasal dorsum and the fistula, close to the midline, was circumcised. The fistula led into a channel which ran between the skin and the perichondrium toward the second fistula. At the inferior margin of the left nasal bone the channel continued beneath the nasal bone. In the inferior part of the left nasal bone there was a fistula in the bone as well as in the skin. The inferior portion of the nasal bone was removed. A sac, the size of a pea, was exposed which was situated within a cavity of cartilage (fig. 2). The cartilage was continuous with the left upper lateral cartilage. The sac and the cartilage were removed. An attempt was made to correct the saddle nose by turning over the upper lateral cartilage. This attempt failed, because it was not possible to separate the extremely thin cartilage from the nasal mucosa. For this reason the hump was removed. The skin incision was closed. The lateral fistula was left open and was secondarily closed by a Thiersch flap. A saddle nose resulted. It is planned to correct this in a later period of time. Microscopically the sac consisted of inflamed connective tissue which was lined by a thick epidermis. In the specimens no hairs were found.

COMMENT

In this case there was a congenital dermoid cyst at the nasal dorsum which was drained by two fistulae. The history and the photos, taken of the patient as a baby, proved that the cyst was actually congenital. It is difficult to state as to whether the fistulae were likewise primary; viz., congenital or secondary. It is likely that the lateral fistula was secondary; viz., caused by an infection of the cyst which had to be lanced. This is proved by the history as well as the finding of scarred skin which surrounded this fistula. But no definite statement can be

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FIG 1 PICTURES TAKEN BEFORE OPERATION SHOW THE FISTULA AT THE NASAL DORSUM AND AT THE LATERAL SURFACE OF THE LEFT NASAL BONE

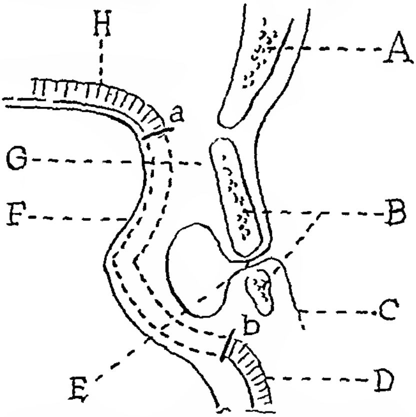

FIG 2 DIAGRAM OF THE SURGICAL FINDINGS

A Frontal bone, B Nasal bone, C Skin, D Anterior wall of cartilaginous nasal capsule, E Fistula leading into dermoid cyst, F Nasal mucosa, G Paranasal space, H Cartilaginous roof of nose, a–b This part of cartilage disappears when nasal bones are formed In the presented case this part of cartilage did not disappear

made as to whether or not the baby was born with the fistula in the midline of the nasal dorsum

The finding at operation (fig. 2) was interesting. The dermoid sac was situated beneath the left nasal bone and communicated with the outside by a narrow channel which ran through the bone as well as through the skin. Under normal conditions there is a nasal mucosa beneath the nasal bones; consequently one should expect that the dermoid sac was lying upon nasal mucosa. This, was, however, not the case. The sac was not lying on nasal mucosa but on cartilage, and the cartilage was continuous with the upper lateral cartilage of the nose.

In order to understand the surgical findings the normal development of the dorsum nasi must be recalled.

We have made interrupted serial section through the external nose and cribriform plate in two new-borns. Both specimens were cut in the sagittal plane. The specimen I was taken from the skull of a female new-born which died one and one-quarter of an hour after delivery from a cerebral hemorrhage. In this specimen the frontal bones were removed. The specimen II was taken from a male still-born baby which lived 15 minutes prior to the delivery and died from a strangulation with the umbilical cord.

The anterior wall of the nose consists of a cartilaginous plate which is part of the chondrocranium and which is bounded by the frontal processus of the superior maxilla on either side. The cartilaginous plate extends down to the tip of the nose and is continuous with the crista galli and the cribriform plate as well as with the cartilaginous septum. In the male new-born there is an enchondral ossification in the crista galli (fig. 3). There are no anastomosing blood vessels between the skin of the dorsum nasi and the nasal mucosa.

The cartilaginous cribriform plate shows numerous foramina which are filled with olfactory fibres, blood vessels and loose connective tissue. The ramus anterior of the anterior ethmoidal nerve runs in the prenasal space and has no communication with the nasal mucosa (fig. 4). In a later period of life, when the anterior wall of the cartilaginous nose has disappeared, the nerve runs within the nasal mucosa covering the nasal bones.

On the outside of the anterior wall of the cartilaginous nose the frontal bone and the nasal bones form by intramembranous ossification; viz., by metaplastic ossification of connective tissue. The frontal squama is divided in two parts which in the midline are connected by connective tissue forming the frontal suture. Above the nasal bones, the frontal suture becomes markedly enlarged. This area was called by Schwalbe (1, 2) "fontanella metopica" or "fontanella mediofrontalis." The fontanella metopica is the last part of the frontal suture to become ossified, and as a matter of fact, the fontanella may remain partly unossified even in adults. The space between the frontal squama and the cribriform plate is filled with connective tissue which extends from the frontal process of the maxilla on one side to that on the other side and accumulates in front of the crista galli; viz., in the area of the foramen coecum of adults. Here the connective tissue is embraced by the cartilaginous processus alares of the ethmoid which originate from the anterior wall of the cribriform plate and extend toward the frontal squama. The nasal process of the frontal bone is not yet developed in the new-born (Holl 3) and for this reason there is likewise no foramen coecum which, in adults, is situated in the nasal process of the frontal bone and leads into a short channel, ending as a cul-de-sac within the nasal process (Holl).

Microscopically this area presents the following findings: The frontal squama consists of bone trabeculae which form a loose network and run in all directions of the space. On the outside the bone trabeculae are approximated, forming a layer of more solid bone. The spaces between the bone trabecles contain a fine network of connective tissue with osteoblasts, ostoclasts and occasionally lymphocytes. The trabecles consist of web-like bone which forms by metaplastic ossification of connective tissue. We could not find the veins of Breschet in the frontal squama of the new-born.

Lateral to the midline the dura on the inside of the frontal squama consists of an internal and external layer. The internal layer is covered by a mesothelium and consists of loose

connective tissue, capillaries and cavernous spaces. The external layer consists of a firm connective tissue and only a few blood vessels. Within the external layer, the frontal squama develops by metaplastic ossification (fig. 4). Toward the cribriform plate the two layers of the dura separate. The internal layer covers the cribriform plate. The external layer runs toward the inferior margin of the frontal squama. At this site a part of connective tissue runs toward the prenasal space at the nasal dorsum; another part joins the

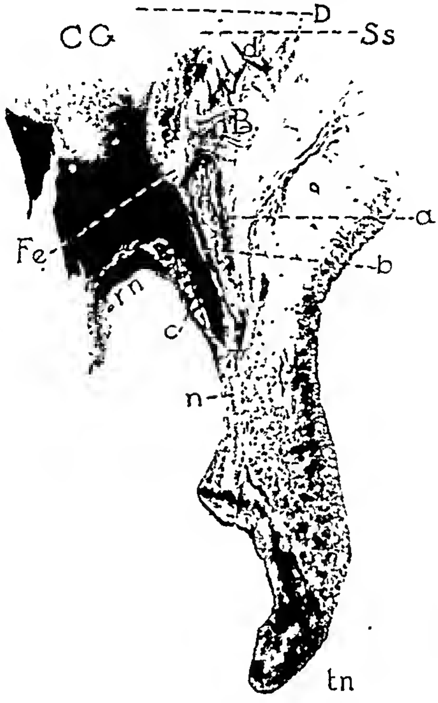

Fig. 3. New-Born Male

The section runs between the two parts of the frontal squama. CG: Crista galli, D: Dura, nB: Nasal bone, a: External periosteum of nasal bone, h: Prenasal space, tn: tip of nose, n: Anterior wall of cartilaginous nasal capsule, c: Internal periosteum of nasal bone, rn: roof of nose, Fe: Foramen coecum.

boundary of the frontal squama and then runs upward along the outer surface of the frontal squama (fig. 4).

In the midline there is a great amount of loose connective tissue, a few arterioles, numerous veins and cavernous spaces which run toward the superior longitudinal sinus (fig. 5). The veins originate; (1) in the lamina externa of the dura, (2) in the skin of the nasal dorsum and (3) in the nasal mucosa.

The space between the nasal bones and the anterior wall of the cartilaginous nose was called by Gruenwald[4] "the prenasal space" (fig. 3). The microscopic examination of this area reveals the following: The ossa nasalia consist of bone trabeculae which form a network. In the meshes of the network there is a loose connective tissue and only occasionally

osteoblasts. Ostoclasts are absent. The bone of the trabeculae is a web-like bone with a considerable amount of intercellular substance. Whereas the bone trabecles of the frontal squama run in all directions of the space and the bone trabecles of the frontal process of the maxilla run in a horizontal level (Fig. 4), the bone trabecles of the nasal bones are chiefly situated parallel to the longitudinal axis of the dorsum nasi. There is an external and

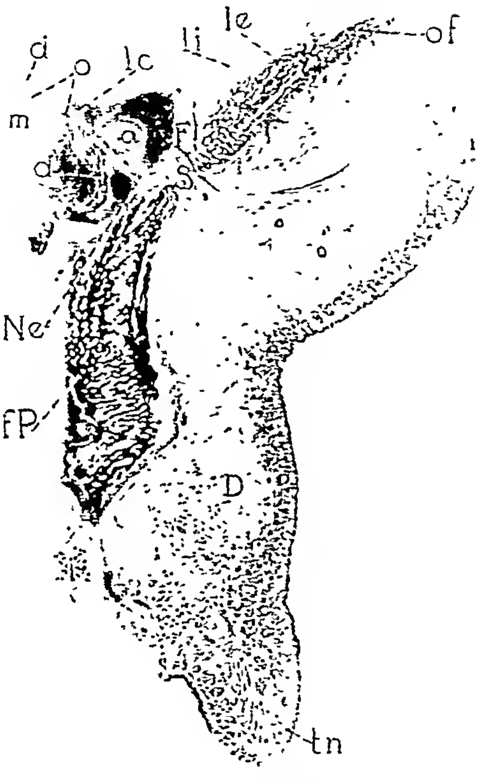

FIG. 4. NEW-BORN MALE

d: Dura, o: Olfactory fibres, lc: cribriform plate, a: Cavity in the lateral part of the cribriform plate filled with embryologic connective tissue and the external branch of the anterior ethmoidal nerve; this space communicates with the subarachnoid space as well as with the prenasal space; F: Frontoethmoid suture; S: Suture between frontal bone (oF) and frontal process of maxilla (fP): li, le: Internal and external layer of dura, D: Skin, tn: tip of the nose, Ne: Anterior branch of anterior ethmoidal nerve, d: Blood vessels and olfactory fibres entering the cribriform plate, m: Nasal mucosa.

internal cortex (fig. 3), the former being thicker than the internal cortex; furthermore, there is an internal and external periosteum and osteoblasts between periosteum and cortex. This indicates that the nasal bones grow by apposition of bone.

The prenasal space is a potential space. Under normal circumstances it is filled with connective tissue which is partly firm, partly loose. The firm connective tissue originates from the external layer of the dura, forms the internal periosteum of the nasal bones (fig.

5). At the inferior margin of the nasal bones a part of the connective tissue, containing capillaries with marked perivascular infiltration, extends toward the top of the nose while the other part form the outer periosteum of the nasal bones and extends upward toward the frontal squama (figs. 3 and 5). The loose connective tissue is found between the anterior wall of the cartilaginous nose and the internal periosteum of the nasal bones. It is con-

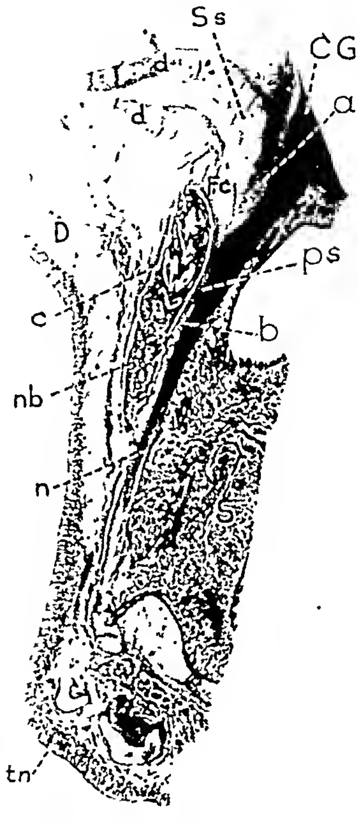

FIG. 5. NEW-BORN FEMALE

Paramedian section. Ss: Superior longitudinal sinus; CG: Crista galli; a: Cerebral portion of prenasal space filled with embryologic connective tissue, ps: Nasal portion of prenasal space, b: Internal periosteum of nasal bone, S: Mucosa of nasal septum, tn: Tip of nose with cartilages, n: Anterior wall of cartilaginous nasal capsule, nb: Nasal bone, c: External periosteum of nasal bone, D: Skin, d, d: Dura, Fc: Foramen coecum.

tinuous with the loose connective tissue which fills the space between the crista galli and the frontal squama, and extends toward the inferior margin of the nasal bones where it joins the perichondrium of the anterior wall of the cartilaginous nose. Within the loose connective tissue there are many capillaries and cavernous spaces.

To sum up, in the new-born the anterior wall of the nose consists of one single cartilaginous plate which on the outside is covered by connective tissue and skin.

The connective tissue originates from the dura. During the intramembranous formation of the nasal bones the connective tissue and the skin become separated and between the cartilaginous wall of the nose and the nasal bones there is the prenasal space, filled with connective tissue of dural origin. Soon after birth the cartilage of the nasal capsule disappears at all sites where it comes in contact with bone. Consequently, the cartilage beneath the nasal bones disappears while the cartilage below the nasal bones persists and forms the upper and lower cartilages of the nose.

These findings shed a light upon the findings obtained at operation of the presented case. According to Ewing[5] the origin of the dermoids of the scalp is explained by an imperfect separation of dura and skin during the intramembranous formation of the cranial bones. Apparently the same mechanisms are responsible for the dermoids of the nasal dorsum as pointed out by Brunner and Harned[6]. Parts of the ectoderm do not separate from the dural connective tissue which covers the cartilaginous nose. When the nasal bones are formed, the displaced parts of ectoderm are situated in the prenasal space; viz., between cartilaginous nasal wall and nasal bone. The displaced parts of ectoderm advance eventually to the formation of dermoids which may or may not remain in connection with the skin. In the first case, there is a primary fistula which runs through the nasal bones. In the second case a fistula may develop when the dermoid becomes infected and the infection breaks through the nasal bone and the skin, forming a secondary fistula.

According to this theory the dermoids of the nasal dorsum are caused by a displacement of ectoderm into the prenasal space. The presented case demonstrates that in these instances the abnormal development does not concern only the ectoderm, but likewise the mesoderm because in the area of the dermoid the anterior wall of the cartilaginous nose did not become absorbed. In other words, in the presented case the dermoid of the nasal dorsum was associated with a persistance of the cartilaginous nasal capsule in the area of the dermoid (fig. 2).

The presented case is furthermore interesting because the brother of the patient presented several auricular fistulae. In this case there were draining sinuses on both sides in front of the auricle and on the posterior surface of the lobule, but there was not pathology at the nasal dorsum. The pathology of the auricular fistulae is not definitely understood. Some embryologists consider them to be remnants of the first branchial cleft; the majority of embryologists and otologists, however, believe that the auricular fistulae, if they do not extend into the tympanic cavity or the pharynx, result from an incomplete fusion of the colliculi branchiales; viz., of the cutaneous nodules which are located close to the first branchial cleft and form the auricle by fusion (His[7], Grunert[8], Pastore and Erich[9], Congdon, Rowhanavougse, Varanusaria[10], Ruttin[11], Weaver[12]). It is an established fact, that this malformation originates from the integument of the body, from which likewise the dermoids of the nose take their origin. This indicates that in the presented cases, concerning brother and sister, the skin of the face exhibited a tendency of developmental deviations, causing dermoid cyst of the nose in the sister and auricular fistulae in the brother.

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IN MEMORIAM

Warren B. Davis, the Editor of this journal and third President of The American Society of Plastic and Reconstructive Surgery died on July 7, 1947.

The death of Doctor Davis comes as a shock to many medical friends who recall his good appearance and activities at the annual meeting of the American Society of Plastic and Reconstructive Surgery in Kansas City. At this meeting he was unanimously commended for his skillful management of the Journal and urged to continue as Editor-in-chief.

Dr. Davis was ailing in May and did not feel well enough to attend the Nashville meeting of the American Society of Plastic Surgeons.

Shortly after this meeting, Doctor Straatsma, Doctor Kitlowski, and I visited him at his home in Philadelphia and we were all disturbed by his evident loss of weight and physical energy. In spite of these handicaps, Doctor Davis insisted on making an orderly disposal of all current articles for publication. Indeed, his main concerns were the present and future needs of this Journal. The Journal of Plastic and Reconstructive Surgery will be his permanent memorial.

Warren Davis was definitely one of our own and he occupied a special place in the heart of every society member. He was a man of international reputation in the field of harelip and cleft palate surgery but he will also be remembered for his qualities as a friend and fine gentleman.

Dr. Warren B. Davis, the son of Luther A. and Mary Donnohue Davis, was born on the Cave Spring Stock Farm, Jessamine County, Kentucky, on September 6, 1881. His father was a great-great nephew of James Wilson, one of the signers of the Declaration of Independence, and Pennsylvania's first member of the United States Supreme Court. His mother was a great-great niece of Daniel Boone, and also a direct descendant of Oliver Cromwell.

Dr. Davis obtained his early education in the public schools of Jessamine County, Kentucky, and graduated with first honors in 1895. From 1898 to 1905 he took a special scientific course at Kentucky University, now Transylvania University.

He entered Jefferson Medical College in September 1906 and was graduated with honors in 1910. He received first appointment as interne in the Jefferson Medical College Hospital, serving a residentship there for eighteen months. At the end of his interneship, he was awarded the Corinna Borden Keen Research Fellowship, and during the following year did research work in the laboratories of Professor Ludwig Pick of the University of Berlin, Germany, and in the Friedrichshain Krankenhaus. The result of this work was published in a monograph entitled "Development and Anatomy of the Nasal Accessory Sinuses in Man". He entered private practice in Philadelphia in January 1913, at which time he was appointed Clinical Assistant in Surgery at Jefferson Hospital.

In 1931, with J. Parsons Schaeffer, he was awarded the Gold Medal, Class Two, for excellence of presentation of researches illustrating embryology, devel-

Warren B. Davis, M.D.

opment and anatomy of the paranasal sinuses, at the Annual Meeting of the American Medical Association in Philadelphia.

In 1936, he was made Clinical Professor of plastic and reconstructive surgery at Jefferson Medical College and maxillofacial surgeon at Jefferson Hospital. He was also associated with the surgical staffs of several other hospitals in Philadelphia.

During his career, he became internationally known for harelip and cleft palate surgery, and wrote numerous monographs on those and other medical subjects. He was the first Editor of the Journal of Plastic and Reconstructive Surgery.

During the First World War, Dr. Davis served on the War Department's Advisory Board of Pennsylvania and later as a Captain in the Army Medical Corps, in charge of the School of Maxillofacial Surgery.

By appointment of the Surgeon General, he served as a member of the national faculty for plastic and maxillofacial surgery in the Second World War.

He received an honorary degree of Doctor of Science from Georgetown College, Georgetown, Ky., in 1938. He was President of the Alumni Association of Jefferson Medical College in 1942 and from 1941 to 1947 was a member of the Pennsylvania State Board of Plastic Surgery.

He was a Fellow of the American College of Surgeons, and a member of many other societies, including the College of Physicians of Philadelphia, the Academy of Surgery of Philadelphia, the American Academy of Ophthalmology and Otolaryngology, the American Medical Association, the American Society of Plastic Surgeons, the Association of Military Surgeons, the Philadelphia County Medical Society and was a past president of the American Society of Plastic and Reconstructive Surgery.

He was a member of the Union League and the Philadelphia Country Club.

Dr. Davis is survived by his wife, the former Ada Springer, whom he married in 1913, and four sons, Dr. J. Wallace, Warren S., J. Leslie, and Richard C. Davis.

LYNDON A. PEER, M.D.

September 1947

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

BURNS

Romence, H. L.: Common Errors in Burn Treatment. *Am. J. Surg. 73:* 340, Mar. 1947.

Romence holds the view that the treatment which a burned patient receives in the first two hours after injury will largely determine the outcome of the case. Serious burns should be recognized as being surgical problems, and the patient should be taken immediately to the operating room, where sterile treatment can be instituted. Petrolatum jelly is employed most widely today, but eventually dry sterile fine-mesh gauze placed over the burned area may prove to be the dressing of choice. Burns should have adequate dressings, for moderate pressure and immobilization are of great importance. Errors are commonly made in cleansing burns too extensively and too vigorously, in changing the original dressing prematurely and in changing subsequent dressings too frequently. The most common error in plasma therapy is the giving of too little plasma during the first 48 hours and too much during the ensuing few days. Other common errors include adequate whole blood transfusions, failure to maintain satisfactory nutrition and the prevalent failure to apply skin grafts early. One of the saddest spectacles is the presence of infected exuberant granulations long past optimum grafting time. There is no easy magical treatment for burns, permitting one to leave "arm-chair" orders, for, despite treatment fads, hard work and thoughtful management will continue to be necessary.

Moore, F. D., Peacock, W. C., Blakely, E., and Cope, O.: The Anemia of Thermal Burns. *Ann. Surg. 124:* 811, Nov. 1946.

According to Moore and his associates, anemia so severe that wounds will not heal without massive transfusions, has been acknowledged as a common complication of extensive deep burns. In the beginning the origin of this anemia was ascribed to external loss from infected granulations, but more recently numerous other factors have been recognized as important. Likewise a true reduction in red-cell mass should be differentiated from the false anemia following hemodilution. In an effort to measure the red-cell mass directly the authors investigated the anemia by serial studies of the red-cell mass and bone marrow activity with a radioactive isotope of iron.

True anemia is found only in patients having full thickness burns, but on occasion it may be absent even in fatal burns. The etiology of the anemia, however, must include hemolysis, cryptic wound hemorrhage, iron deviation, variation in gastro-intestinal absorption, infection and bone marrow depression. It was observed incidentally that contamination and subsequent infection are truly inevitable in any extensive burn even with the administration of massive doses of penicillin.

Despite exhaustive studies and careful analysis by the isotope method it was impossible to ascribe the relative importance of these causes with accuracy. However, the disordered iron metabolism and depressed marrow function were found to be important factors.

The therapy of anemia associated with severe burns is accomplished better by anticipation and early replacement than by late recognition and delayed transfusion. Serial objective measurements of the red-cell volume offer the best method for distinguishing between true and false (hemodilution) anemia in the clinical care of the seriously burned patient.

SKIN GRAFTS

Conway, Herbert: Results following the Pigment Injection (Tattooing) of Port-wine Stains and Skin Grafts. *Bull. Am. Coll. Surgeons 32:* 87, Feb. 1947.

Conway presents a brief report with colored microphotographs and photographs of 12 patients who received permanent pigment injections by means of tattooing for the obliteration of port-wine stains and for matching the color of skin grafts on the face.

Colored microphotographs are shown demonstrating the depths to which the pigment is injected, and details are given concerning the colors to be used, and the methods by which the pigment is injected.

In the treatment of port-wine stains there has been satisfactory neutralization of the color effect in all cases. In the matching of skin grafts to the adjacent normal skin, the results have been more spectacularly successful.

House, Peyton: The Activation of Skin Grafts. *J. Exper. Med. 83:* 383, May, 1946.

House points out that more than three-quarters of a century ago Thiersch asked whether better success might not be attained in the grafting of skin if the apposed surfaces were already in an excited state. Members of the guild who had carried through remarkable plastic operations in India during the previous centuries, always pounded the skin with wooden slippers considerably before they used it. It has been shown that skin takes best, other things being equal, on a bed of vascular responsive tissue. There has been no test of what will happen if the cellular components of the graft itself are stimulated prior to transfer.

House made the following observations on rabbit skin rendered hyperplastic by various agents. The donor area healed much more rapidly than usual and became infected less often. The hyperplastic skin unites with the underlying tissue sooner than the normal skin of the same individual, and it obtains a blood supply more promptly and more abundantly. The grafts were readily obtained, could be cut exceedingly thin and contracted less. Certain hazards and limitation of hyperplastic tissue were noted. In an avascular area the normal grafts were better able to survive than the thick hyperplastic grafts, which often died *in toto*, their metabolic needs being so imperative. When skin had been over-stimulated, the grafts died. They became infected more easily

but showed remarkable ability to proliferate amidst pus.

The author concludes: "From the observations as a whole it is plain that any attempt to utilize stimulated human skin for grafting purposes would require the utmost care to avoid excessive stimulation or other injury to the tissue and to prevent bacterial infection. It may well be that activation will remain a principle, not become a practicality."

TUMORS

Amersbach, J. C., Walter, Elsie, and Sperti, George: Treatment of Basal Cell Epithelioma by Injection of Tissue Extract. *Arch. Dermat. & Syph. 54:* 119, Aug. 1946.

A preliminary report from The Skin and Cancer Unit of the New York Post-Graduate School and Hospital is reported by Amersbach and his associates. Small basal-cell epitheliomas, varying in size from that of a pea to 3 or 4 cm. in diameter, were photographed and biopsies were done. At weekly intervals intradermal injections of either liver or spleen extract were given, the average amount being 1 c.c. The injection infiltrated the lesion and surrounding tissue for about ½ inch. Because of the possibility that regression of the tumors might be due to sclerosing action of the material, several patients were treated with dextrose of a concentration equal to that of the spleen extract.

Twenty-one patients were treated, 7 with liver extract and 14 with spleen extract. One patient failed to respond to the treatment, 14 continued treatment to complete regression of the lesion as shown by final biopsy. The other 6 patients are still under treatment but all neoplasms are regressing. Injections of dextrose failed to produce regression. The number of injections required varied from 3 to 20. The extract seemed to have no effect on normal tissue. In a follow-up of one to two years the patients treated have shown no sign of recurrence, and all will be checked at intervals for 5 years.

Jackson, Harry, and Balkin, Ruth: Glomus Tumors (Angioneuromyomas). *Arch. Surg. 53:* 100, July, 1946.

Jackson and Balkin report the case of a negro man, 68, who had a small nodule in the skin of the volar aspect of the forearm for 25 years. Growth was slow, pain had been present for some years and severe in the last 2 years. Examination showed a mass, 4 c.m. in diameter, attached to the skin and movable on the muscle. On excision the mass was found to be a glomus tumor.

These tumors are small, usually 2 to 5 mm. in diameter, but have been previously reported up to 3 c.m. They are firm, usually blue or red in color. They are located in the superficial fascia and usually are movable. When the growths are situated beneath the nails of the digits, pain is severe. These tumors are painful out of proportion to their size. They are to be distinguished from fibromas, angiomas, *et cetera.* The treatment is excision. The microscopic picture shows layers of large epithelial glomus cells with myelin and non-myelin nerve fibers.

Zakon, S. J., and Gault, J. T.: Giant Nevus Pigmentosus and Verrucosus of the Thigh Treated by Complete Excision and Primary Grafting. *Arch. Dermat. & Syph., 54:* 230, 1946.

Zakon and Gault report a case of a white man, 40, who had a pigmented verrucous, hairy nevus, dark brown to black in color, involving the inner aspect of the thigh and leg over an area of 8 to 12 inches. Numerous fissures with some infection and a foul odor were present. Biopsy showed an active melanotic nevus. The entire lesion was excised and grafted 3 weeks later.

In discussion, Dr. *H. E. Michelson,* of Minnesota, stated: "I believe that dermatologists have finally learned that this type of lesion should be treated by surgical excision first and not last. I think it is a great mistake for any other type of treatment to be tried before excision is used. A certain percentage of these large nevi do become malignant, and removal is the best prophylaxis."

Arrick, Myron S.: Stem Cell Lymphoma of the Newborn. *Arch. Path. 42:* 104, July, 1946.

A case of congenital lymphoma of the stem cell type is reported by Arrick. As far as he can ascertain, this is the first case to be reported.

At birth an irregular, smooth, salmon pink, waxy tumor was located over the manubrium. A palpable node was found in the left axilla. The skin and subcutaneous tissue were involved. The tumor clinically suggested lymphangioma but the biopsy showed leukemia cutis. Improvement followed roentgen therapy but was transitory, and the growth became uncontrollable in less than 2 months, with a fatal termination.

NOSE

Becker, Oscar J.: Aids in Rhinoplastic Procedures. *Am. Otol. Rhin. & Laryng.*, *55:* 562, Sept. 1946.

In planning a rhinoplasty Becker places the preoperative photograph on an x-ray view box and sketches the desired profile on the reverse side. In this manner, the sketch shows the various points to be considered during the reconstruction.

Shaping of the nasal tip is considered by the author as one of the important steps in obtaining a natural "non-surgical" appearing nose. This depends on proper modeling of the lower alar cartilages. The procedure followed by Becker consists in splitting the lower lateral cartilages into two fields, the upper and lower, the removal of a wedge at the angle of the two crura, and of a segment of the anterior border of the medial crus.

The advantages of this method are:

(1) The upper convex portion of the alar cartilages, which give an undesirable appearance to the tip, are removed completely.

(2) A complete skin lining is present over the upper half of the alar field, preventing scar contraction.

(3) The lower field of the lateral crus and the complete medial crus are made more accessible.

For correction of a retracted columella and for placing dorsal and columellar transplants for saddle nose, an incision is made along one side of the anterior border of the medial crus for its entire length; the membranous septum is not incised. The skin of the columella is retracted, and a pocket dissected between the medial crus and down to the anterior nasal spine. The transplant is placed in this pocket, and a few small sutures inserted between the skin of the columella and that of the medial crus.

The cleft tip is corrected through an incision along the anterior border of the medial crus. Cartilages are dissected free, excess tissue removed and the cartilages drawn together by mattress sutures.

Editorial Comment: The reconstruction of an oversized tip is the crux of any rhinoplastic procedure.

Many of the older corrective methods for narrowing the nasal tip which recommend excision of the vestibular lining together with strips of alar cartilage, are still being cited. This excision of the vestibular lining is frequently followed by unsightly lateral depression, which is a pathognomonic sign of plastic repair. Failure to shape the alar cartilages in all dimensions is responsible for an unnatural appearance of the tip. The vestibular lining should never be sacrificed in the process of narrowing. The alar cartilages should be shaped following complete exposure of their external surface through a vertical section near the septum. The inner surface of the cartilages remains attached to the vestibular skin, thus holding the shaped part in place.

The vestibular flaps are thoroughly resutured in place, thereby eliminating exposure of any raw surfaces and preventing formation of adhesions in this area.

Foman, Samuel; Syracuse, Victor; Bolotow, N., and Pullen, M.: Plastic Repair of the Deflected Nasal Septum. *Arch. Otolaryng.* *44:* 141, Aug. 1946.

The accepted view that the maintenance of the cartilaginous dorsum and tip depends on the support of the septum is challenged by Foman and his associates. This concept, they contend, precludes adequate correction of deformities of the septum, and a new theory is advanced.

The authors believe that according to the law of mechanics the septum under static conditions is a redundant member furnishing no support whatever. It becomes a factor of support only when crushing forces from without or traction forces from within are applied. They attempt to show mathematically that in the nasal pyramid horizontal and vertical forces balance out, and the septum is merely a reserve safety factor.

Saddling of the dorsum following a high submucous resection is not the result of lack of septal support but of internal stress aris-

ing from cicatrization In the lower cartilaginous vault there is even less dependence on the septal cartilage for support than in the upper and lower ones Clinically, Foman *et alii* observed that the tip of the nose maintains its position in cases of multiple fractures and impaction of the septum

On the basis of this new theory a procedure for septal reconstruction is outlined

(1) Through incision in the membranous septum a free cartilage graft is inserted into the columella not to provide support but to prevent its retraction The graft is held in place by mattress sutures posteriorly

(2) The following step is the bilateral incision, transection of the septum caudally and freeing it down to the nasal spine

(3) The obstructing septal cartilage, irrespective of its location, is removed as far as necessary Saddling due to subsequent contracture is prevented by reinsertion of the resected or preserved cartilage The graft is held by mattress sutures

Editorial Comment Most septal deflections requiring surgery are not limited to cartilage alone but also involve the vomer, and usually necessitate wide exposure for visualization of the posterior parts

As a rule, excision should be limited to those parts of the septum which cannot be reset by immobilization or criss crossing The septal structures which are not designated for removal are best left attached to the mucoperichondrial flap on one side The anterior part of the septum which is exposed at the dorsum in the rhomboid space above the tip should always be left intact in an adequate amount to prevent its collapse The anterior border of septal cartilage causes the columella to project forward and should also be kept intact or properly straightened out to assure its position A columellar strut is required only in those instances where the quadrangular cartilage is under developed (due to injury) or has been sacrificed by previous surgery Only an autogenous septal graft should be inserted, otherwise absorption and subsequent retraction will occur

Elsbach, E. J.: Cartilaginous Septum in the Reconstruction of the Nose; A Modified Procedure. *Arch Otolaryng 44* 207, Aug 1946

The role of the cartilaginous septum in the reconstruction of the nose is discussed by Elsbach A "modified operation" for removal of the anterior distorted part of the septal cartilage is described The author stresses its importance in cases where the displaced septal segment is markedly deformed or is too short, making simple resection impossible

The procedure outlined is that of sub mucous resection with a strip of cartilage left along the dorsum The displaced anterior part of the septal cartilage is excised, and an autogenous cartilage graft inserted in the columellar bed

Elsbach calls attention to the importance of the septum as a supporting structure of the nose

JAW

Kazanjian, V. H.: Spontaneous Regeneration of Bone Following Excision of a Section of the Mandible. *Am J Orthodont & Oral Surg 32* 242, Apr 1946

A case of excision of a section of the mandible followed by spontaneous regeneration of bone is reported by Kazanjian

In 1935, the patient, a 10 year old white boy, underwent an operation for removal of a tumor of the left mandible in the region of the angle and the ramus The pathologic report was giant cell tumor The parents would not consent to further operation until January, 1940 An appliance consisting of an upper and lower wire splint carrying 2 buttons one at the upper second molar region and the other at the lower premolar region, was constructed before operation A bar supplied with a prong at each end extended from the upper button to the lower When the bar was in position, the ends of the prongs were slightly pressed together, thus making a loop around the button The bar could be lengthened or shortened by turning a screw At operation the mucoperiosteum was dissected from the mandible on the inner side of the jaw, and through a stab wound in the face a Gigli saw was passed around the mandible at the site of the lower left first molar, which had previously been extracted, and the mandible was cut through at this point The mandible was also cut across at the level of the sigmoid notch, and the specimen was removed, leaving in the

mucoperiosteum. Suturing and drainage were carried out, and tbe splints previously prepared were attached to the teeth to hold the anterior fragment of the mandible in correct occlusion.

Recovery was uneventful; postoperatively roentgenograms taken 5 montbs later showed regeneration of bone. Six months after the operation, the appliance having been removed from the teeth occlusion was quite satisfactory. There was no appreciable external deformity, and the bone regeneration had made bone grafting unnecessary. The pathologic report was ossifying fibroma of the mandible.

Tweed, C. H.: The Frankfort-Mandibular Plant Angle in Orthodontic Diagnosis, Classification, Treatment Planning, and Prognosis. *Am. J. Orthodont. & Oral Surg.*, *32:* 175, Apr. 1946.

Tweed outlines a simple metbod for obtaining a Frankfort-mandibular plane angle. In essence, a line connecting tbe orbitale and tragion is projected posteriorly beyond the tragion at least 6 or 8 inches. Another line formed by the lower border of the mandible is projected until it intersects the first line. The Frankfort-mandibular plane angle would be formed at tbe intersection of the 2 lines.

Prognosis for ortbodontic treatment of patients with the Frankfort-mandibular plane angle falling within range of 16 to 28 degrees is excellent for those with the angle nearest the 16 degree extreme, and good for those patients with the angle nearest the 28 degree extreme. In cases of the Frankfort-mandibular plane angle falling within the range of 28 to 30 degrees, the prognosis would vary from good at 28 degrees to fair at the 32 degree extreme. In csses of the Frankfort-mandibular plane angle falling within the range of 32 to 35 degrees, the prognosis is fair at 32 degrees snd not favorable at 35 degrees. In cases of the plane angle fslling within the range of 35 degrees upwards, the prognosis is not favorable at 35 and very poor at an extreme such as 45 to 55 degrees. It is in these latter cases that the role of the plastic surgeon is paramount, for these patients cannot be helped by ortbodontia and will often require reconstructive surgery.

Editorial Comment: Although this is an srticle written by an orthodontist for orthodontists, it should be read by every plastic surgeon doing maxillofacial surgery. Part of the art of plastic surgery lies in differentiating those cases which can be best handled by the orthodontists from those which can be best handled by the plastic surgeons.

In tbis abundantly illustrated article is one of the finest discussions tbis reviewer has ever read on facial esthetics and facial developments.

HAND

May, Hans: Tendon Transplantation in the Hand. *Surg. Gynec. & Obst.*, *83:* 631, Nov. 1946.

May states that tendon transplantation is used to fill a tendon defect or replace destroyed tendon. If the defect is due to infection, operation should be delayed for 3 months. Penicillin should be given for 2 days preoperatively and 4 days postoperatively.

Autogenous tendon tissue is the best graft material for bridging tendon defects. Palmaris longus, the long extensor tendon of the fourth and fifth toes, and sometimes the flexor sublimus tendon are a source of the graft. A tendon graft has little chance to survive and function unless the gliding tissue of the host area is preserved or, if absent, another gliding tissue is transplanted. Care should be taken to preserve the loose-areolar tissue which surrounds the grafted tendon. If the paratendon cannot be preserved, it must be taken from other sources as a free graft and wrapped around the tendon graft.

The presence of stiff joints whicb cannot be moved passively is a contraindication to any tendon repair.

The operation, as described by May, is done under general anesthesia with a blood pressure cuff tourniquet inflated in place. Incisions should be made so as not to interfere with the functions of the hand. Lateral or bayonet incisions are best in the fingers, parallel to the palmar flexion crease and transverse at the wrist. All tendon adhesions should be divided and all surrounding scar tissue be excised, but tbe nerve should not be injured. Handle tendons and nerves gently. Excise all scarred, frayed or devitalized tendon.

If the tendon defect is in the palm and involves the sublimis and profundus tendon, only bridge the gap in the profundus tendon.

The proximal segment of the sublimis tendon is the source of the graft, and the distal segment is excised. The graft, after fixation, should be under moderate tension. The position of the hand is flexed 120 degrees at the wrist and 120 degrees at the metacarpophalangeal joints. If the sublimis tendon is not available for grafting, the tendon of the palmaris longus or long extensor tendon of the fourth and fifth toes can be used.

Primary repair of the tendons within the tendon sheaths should he attempted only under the most favorable circumstances, because scar formation within the sheath not only impairs the immediate results but also makes secondary repair more difficult. If the sublimis and profundus tendons are divided, it is advisable to bridge only the profundus tendon. The graft source is the divided sublimis tendon or palmaris longus or long extensor of the fourth or fifth toe. A lateral or bayonet incision is used to mobilize the adherent tendon stump. The sublimis tendon and its two slips are excised. The proximal tendon stumps are lacerated from a separate incision in the palm or wrist. The graft is sutured to the distal stump of the profundus tendon. In most cases a new annular ligament must be constructed to hold the tendon in place over the volar surface of the fingers. Another tendon graft is used for this purpose as described by Burnnell. If the distal tendon segment is too short, it should be sacrificed and the graft fastened directly to the bone. The finger wound is closed in layers and after this, the proximal end of the graft is attached to the proximal segment of the tendon. The remaining wounds are then closed in layers and the hand splinted.

On the dorsum of the hand grafts are less often indicated. When they are needed, the long extensor tendon of the fourth or fifth toe may be used. If the proximal phalanx or proximal interphalangeal joint is involved, fascia lata is used as a graft.

After-treatment is as important as the operation. The proliferative stages last 2 weeks as the tendon stumps become united. During this period a molded plaster cast splint is used with the position such that the suture line is under a minimum of tension. After 2½ weeks, the splint and dressings are taken off and the sutures removed. Daily warm saline baths and active motion are begun. After 3 weeks local heat, massage and passive exercise are added.

Hardy, Sidney B., Lieut. Comdr. (M.C.) USNR: Rehabilitation of the Injured Hand. *Am. J. Surg., 22:* 352, Sept. 1946.

Injuries are classified by Hardy as (1) Burns, (2) Contractures, (3) Traumatic amputations of digits, (4) Lacerated tendons, (5) Post-infectious deformities, and (6) Multiple injuries involving tendons, nerves and bones.

Burns: Third degree burns form a dense cicatrix in healing which prevents normal function of joints. Deep burns involve tendons and joint capsules producing a typical deformity, hyperextension of the metacarpophalangeal joints, flexions of the first interphalangeal joint and hyperextension of the distal joints of the fingers. Contractures developing across web spaces prevent abduction and adduction. It is desirable to treat these patients as early as possible after injury to supply a good skin covering.

Contractures: These may be due to lacerations, penetrating wounds, *et cetera*. The depth and extent of involvement of these contractures may vary considerably, depending on the initial wound. Following conservative treatment including physiotherapy, they improve for a time but as a rule surgery is ultimately required.

Traumatic Amputation of the Digits: If only one of two digits or merely parts of digits are traumatically amputated, a useful hand can be obtained with the remaining digits if the amputation stumps are covered satisfactorily. Surgery may be needed to replace atrophic skin over stumps, remove neuromas or deepen adjacent web spaces.

Lacerated Tendons: If primary healing of wounds has occurred without primary tendon repair, secondary tendon repair with tendon graft often gives satisfactory results.

Post-Infectious Deformities: Most wounds of the hand heal without occurrence of extensive infection. A few patients develop virulent infections with destruction of tissue and contracture deformities. The gliding action of the tendons is destroyed and joint destruction may be a frequent complication.

A painful useless hand may be the end-result.

Multiple Injuries Involving Tendons, Nerves and Bones: These conditions are combination problems of the neurosurgeon, orthopedist and plastic surgeon. Extensive surface scarring is usually present, and circulation is impaired. It is necessary to replace the surface covering with a pedicle graft after the scar has been excised. Orthopedic and neurosurgical conditions should be corrected before final tendon reconstruction is undertaken.

To evaluate the extent of the damage requires a good history including previous treatment, careful examination of the entire extremity and hand, and x-ray examination.

Preoperative treatment consists of:

An original injury must be well healed, allowing 3 to 6 months to elapse before second tendon repair.

Physiotherapy is instituted to maintain good joint motion until the tendons are repaired.

Preliminary operation is carried out, when necessary, to remove scar tissue and to supply good tissue covering.

Operative treatment includes:

Sterile preparation on day before operation.

Preparation, and draping of sterile field.

Administration of general anesthesia, pentothol being good.

Use tourniquet during dissection and have good lighting.

Make incision in hand and in digits along the flexion creases and not over points of pressure. Mid-lateral incisions are made along the digits.

Be gentle in retraction and handling tissues to keep scarring at a minimum.

Remove all scars.

Use pedicle graft from abdomen when it is indicated to replace scar.

Release tourniquet after dissection is complete and ligate bleeding points.

Do tendon grafting now if indicated.

Close wound carefully with 5 closely spaced sutures.

Pressure dressing is always necessary. Splinting with plaster or metal splint may be used.

Excision of burn cicatrix is done with tourniquet in place and is carried down to a good base but leaving the peritendinous tissue. Then grafting is carried out.

Postoperative treatment includes:

Elevating the limb.

Inspecting wound and removing sutures in 7 to 10 days.

In case of tendon work, fix hand in plaster for 3 weeks, then support with elastic bands, and apply physiotherapy.

MISCELLANEA

Freeman, Norman E.: Newer Concepts of the Pathologic Physiology of Shock; Peripheral Circulatory Collapse. *Surg. Clin. No. America*, Dec. 1946, p. 1319.

As pointed out by Freeman, in 1941 an accepted definition of shock was "the clinical condition characterized by progressive loss of circulating blood volume resulting from increased capillary permeability." Recent investigations, however, have cast doubt upon this concept, for it is now recognized that numerous mechanisms are involved in the production of shock. The simplest form involves a failure of return blood flow to the right heart, usually from hemorrhage, and is amenable to replacement therapy if of short duration. If this failure is prolonged, irreversible changes in cell metabolism may be produced.

In a second large group of cases, the peripheral circulatory collapse follows metabolic disturbances of body cells as seen in severe infections. In Freeman's opinion, a similar mechanism may underlie the irreversible shock following prolonged circulatory insufficiency, and studies suggest that the liver is intimately concerned with this stage of irreversibility. Recent investigations have shown that no portion of the circulatory system in the advanced stages of shock functions normally, but precisely which of the abnormalities in cellular metabolism is responsible for shock has not as yet been disclosed. Although we are closer to an understanding of the underlying process of shock, we are still unaware of the ultimate mechanism involved.

Stevenson, Thomas W.: Reconstruction of the Esophagus by a Skin-lined Tube. *Surg. Gynec. & Obst.*, *84:* 197, Feb. 1947.

A method of uniting the upper esophageal segment to the stomach by means of a skin-

lines tube is described by Stevenson as employed in 2 cases in which esophagectomy had been performed previously for carcinoma.

The surgical procedure was divided into 3 stages, extending over 4 months in one case, and 6 months in the other.

In the first stage, the subcutaneous skin-lined tube was formed on the chest wall between 2 parallel incisions at least 9 cm. apart, reaching from the esophageal stoma near the clavicle to the xiphoid. The flap was then tubed with the skin surrace inward. The lateral margins were widely undermined, about 10 cm., and sutured together over the tube.

In the second stage, the lower end of the tube was anastomosed to the stomach by means of an incision in the anterior stomach wall. The final stage was the joining of the esophageal stoma to the tube.

Careful selection of cases is urged by the author in pointing out the fact that in patients with carcinoma one is always concerned about local recurrence or remote metastases. In congenital cases many of the infants have other anomalies, and in stenosis of the esophagus by lye there is extensive scarring, especially at the upper end.

Figi, Frederick A.: The Etiology and Treatment of Cicatricial Stenosis of the Larynx and Trachea. *South. M. J.*, *40:* 17, Jan. 1947.

Complete cure in 24 of the last 27 cases of cicatricial stenosis of the larynx and trachea by means of the open type of operation is recorded by Figi in a report on 42 such patients treated at the Mayo Clinic in the past 16 years.

In reviewing these cases the author describes the various etiologic and pathologic factors involved and the different therapeutic measures used, including a detailed description of the surgical technique being used at the present time.

Traumatic fracture of the laryngeal cartilages and the effect of removal of a laryngeal neoplasm each accounted for more than one-fourth of the total number of cases. Less frequent causes were acute laryngotracheitis, self-inflicted and accidental severing of the trachea, and the use of nasal feeding tubes.

After fracture there is usually a loss of cartilage and distortion or malunion with overriding of the fragments, while perichondritis is the chief pathologic factor in the lesions other than fractures.

The highly successful results of present date with the open type of operation are the effects of advances made in the past 2 decades and are in marked contrast with the almost hopeless prognosis given in such cases prior to a few years ago.

Some time before 1930, Schmiegelow had inserted a rubber tube into the lumen after excising the scar tissue through thyrotomy. Arbuckle, in 1930, made the most important advance when he introduced the use of a free skin graft. Figi, in 1940, advocated the use of an air-foam rubber sponge as a core for holding the skin graft against the irregular surface to be grafted.

The open type of operation is accomplished through a thyrotomy incision under local anesthesia. The scar tissue is excised as cleanly as possible. Well-placed incisions are made in correcting distortion or contracture of the cartilages in order to spring them out into their normal shape. A moderately thin skin graft taken from a non-hair-bearing area is fixed to a core of air-foam rubber sponge by means of rubber cement. The core is then inserted into the lumen and transfixed with silver-alloy wires, over which the tyrotomy opening and the soft tissues are closed. Ten days later the larynx is exposed by means of suspension apparatus. The upper end of the core will be found uncovered because the skin graft over this portion will have sloughed. The core is removed. Usually a series of dilatations over a period of a few weeks to a year will be necessary because of the tendency of the graft to shrink.

AMERICAN SOCIETY OF PLASTIC AND RECONSTRUCTIVE SURGERY

Its Beginning, Objectives and Progress, 1932–1947

JACQUES W. MALINIAC, M.D.

PREFACE

The history of the American Society of Plastic and Reconstructive Surgery is more than the record of a single organization. In a broad sense, it reflects the voluntary movement toward self-regulation which has brought the practice of the medical specialties in this country to its present high point.

To understand the reasons which led to the foundation of this Society, it is necessary to go back to the late twenties and review the opportunities for graduate education and hospital work in plastic surgery at that time. Following World War I, the practice of reparative surgery was almost wholly confined to a small group of surgeons who had acquired experience therein during the war. A slight trickle of new men, headed by Blair, Smith, Ivy, and a few others, entered the field via the services. For the most part, however, there were no plastic divisions in voluntary or municipal hospitals; teaching centers were similarly deficient.

Early attempts to establish such clinics in the municipal hospitals of Greater New York had a direct bearing on the establishment of our Society. In the late twenties, I was assigned to do plastic surgery at City Hospital, Welfare Island. It was soon evident that the clashing interest of the various services was obstructing the establishment of an independent plastic clinic or service. However, through the cooperation of Dr. William Schroeder, then Commissioner of Hospitals, and his successor, Dr. J. W. Greefe, the Department was persuaded to accept my views, and a special plastic division in the city hospitals of Greater New York was created in 1930.

The stubborn fight necessary to achieve this single objective convinced me of the urgent need for organization of plastic surgery in the broad interests of profession and public. The American Association of Oral and Plastic Surgeons, then the only organization in the field, confined its activities to one meeting a year, closed to all but its sharply delimited membership. It was my belief that a great service could be rendered by an association designed to provide an open forum for all engaged in the ethical practice of plastic and reconstructive surgery; to serve as a source of information for members of other specialties interested in plastic problems; and to educate the public on the potentialities and limitations of this specialty.

ORGANIZATION

In pursuance of these goals, a meeting to organize the Society of Plastic and Reconstructive Surgery took place in October of 1931, with founder members

drawn from the eastern states. Representation was sought from every field in which plastic problems are encountered. As the organization grew to include members from all parts of the Union, a more comprehensive title was desired, and "American Society of Plastic and Reconstructive Surgery" was adopted by constitutional amendment in 1941.

The names of John Wheeler, Warren Davis, Arthur Palmer, Clarence Straatsma, and Lyndon Peer are closely identified with the early period of organization. After my two years of chairmanship, Dr. John Wheeler assumed the presidency in 1934. In spite of an illness which partially deprived him of sight, he attended all stated and annual meetings, even when held outside New York. His loyalty to our Society and support of its broad aims contributed greatly to its growth and progress.

Tribute is due also to the sustained interest and service of Dr. Warren Davis, who joined the Society in its second year and, in 1936, became its third president. Drs. Straatsma, Palmer, and Peer, too, made generous contributions of time and effort. All were with the Society from its early years. All served both as general secretary and president (1938, 1940, and 1942, respectively). To Drs. Aufricht and Kitlowski fell the honor of guiding the Society through the late stages of World War II.

At the first annual meeting in October, 1932, a provisional constitution was adopted, citing the following objectives:

(a) To promote and further medical and surgical research pertaining to the study and treatment of congenital and acquired deformities.

(b) To keep the medical profession informed of the scientific progress and the possibilities of plastic and reconstructive surgery.

(c) To stress the great social, economic, and psychological importance of this surgical specialty.

Whatever changes have since been made in the constitution, these have remained the Society's avowed aims; they are still emphasized on its annual programs.

ACTIVE MEMBERSHIP

To foster the development of young men desirous of entering the specialty, the constitution originally provided for two classes of membership, Senior and Junior. The Senior group comprised men with ten years' experience in special or general plastic surgery; only five years was required for junior membership. There was also a special classification based on nature of practice; viz., general plastic, ophthalmic, otorhinolaryngological, and oral.

The constitutional revision of 1941 abolished both the junior membership and the special classification, to the regret of a minority including myself. The former provision, in particular, appeared to fulfill one of the primary aims of the organization by enabling younger men to participate in meetings and come under the scrutiny of their seniors. Junior Members did not automatically become full-fledged members.

CORRESPONDING MEMBERS

In order to lower geographic barriers to the exchange of information and ideas, a corresponding membership was established, including such distinguished foreign plastic surgeons as Kilner (London), Dufourmentel and Veaux (Paris), Axhausen (Berlin), Lexer (Munich), Sanvenero-Rosselli (Milan) and many others. Members of the Society traveling abroad enjoyed courtesies at the hands of these colleagues, who in turn received a welcome hearing at our meetings, either in person or through the presentation of papers. Inevitably, World War II disrupted these contacts. It is to be hoped that the peace will soon see them reestablished in the interests of a resumption of scientific exchange.

MEETINGS

The constitution permits two types of meetings: Stated and Annual. The *Annual Meeting*, held in the fall and lasting several days, consists of dry and operative clinics and sessions for the presentation of papers and motion pictures. In the early years of the Society's existence, its annual meetings were held in conjunction with those of other national societies, such as the American College of Surgeons, American Medical Association and Interstate Post-Graduate Medical Association of North America. This enabled visitors to the larger conventions to attend our sessions, thereby fostering the realization of the second objective of the Society. In 1946, however, it was decided to restrict attendance to members and invited guests. While this has certain physical advantages, it contravenes the broad educational objectives previously described.

Stated Meetings, which consisted of case presentations and round table discussions, were at the outset held two or three times a year, with attendance usually confined to members from the eastern states. The appendix to this paper reveals the high caliber of the programs at these stated meetings. Unfortunately, they began to diminish in frequency in 1941, and none has been held since 1943 when their convocation was left to the discretion of the Executive Committee.

PUBLICATIONS

From the Society's inception the printed word has been invoked in the furtherance of its aims. In 1933, a resolution defining the conditions under which plastic surgery should be practiced was adopted by the Executive Committee and sent to all state medical journals and health periodicals. The wide publication and favorable comment received by this resolution reflected the need and desire for such information at that time. Continuance of this important type of activity falls within the purview of the Public Relations Committee.

Since limited financial resources did not permit the publication of our own proceedings at the start, arrangements were made to have the papers presented at our meetings published, without cost to the Society, in the *Medical Times* and the *Long Island Medical Journal*. Abstracts of the published transactions were sent to every member.

I also arranged for the regular publication of our proceedings in the *Revue de Chirurgie Plastique*, the sole Journal of Plastic Surgery in Europe, edited by Dr. M. Coelst.[1] This international review carried original articles in the language of their authors, accompanied by summaries in English, French, and German. Its editorial board included some of the leading plastic surgeons of Europe and the Americas. It continued to publish our transactions until the outbreak of World War II.

From 1940 to 1946, the Society issued its own proceedings covering presentations at its annual meetings. These were well edited and produced, but their limited distribution resulted in excessive costs. In 1946, it contracted with the Williams and Wilkins Co., Baltimore, for the publication of the *Journal of Plastic and Reconstructive Surgery*, with Dr. Warren Davis as editor-in-chief. This new periodical is one of the Society's most ambitious projects; besides papers presented at the annual meetings, it publishes also selected articles by non-members. However, constitutional provision has still to be made for its continuous management; i.e., the selection of editorial personnel and control of editorial policy.

CONSTITUTIONAL CHANGES

Reference has already been made to the amendment of the constitution in 1941. As the Society continued to grow in membership and scope, it became evident that additional changes were necessary. In the fall of 1943 a resolution was introduced to amend the by-laws. A Committee on Constitution was appointed which, with the aid of counsel, re-wrote the main sections. The new constitution was adopted at the Annual Meeting in 1945.

The 1945 changes injected certain controversial points into the conduct of the Society. In 1946 four additional amendments were submitted with the purpose of (1) removing numerical limitations on membership; (2) enlarging the Executive Committee to include two members elected by the membership without mediation of the Nominating Committee; (3) requiring committee appointments to be approved by a majority of the Executive Committee; and (4) permitting amendment of the constitution by a three-fourths vote of the membership. So far, only the first has been adopted by the Executive Committee, increasing the membership from 100 to 125.

WAR ACTIVITIES

The quasi-military activities of the Society prior to and during American entry into World War II are recorded in the programs of its annual meetings from 1940 on. Under the able presidency of Drs. Aufricht (1944) and Kitlowski (1946) its presentations on wartime plastic surgery were comprehensive in scope and of broad educational value. Many of our members served in Army and Navy plastic centers, remaining at their posts until long after most medical reserve officers had been demobilized.

[1] Editorial offices at 1 Boulevard du Centenaire, Brussels, Belgium.

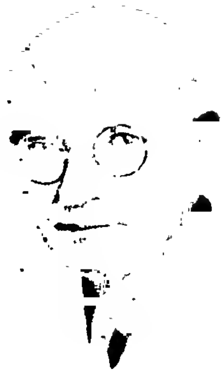
FUTURE OUTLOOK

Real as the accomplishments of the American Society of Plastic and Reconstructive Surgery have been in its fifteen years of existence, it has still a long road to travel to realize its avowed objectives. More and better educational opportunities must be created to assure a continuing, adequate supply of skilled plastic surgeons. There must be a better distribution of plastic clinics to supply the needs of the indigent. Surgical and psychiatric technics must be correlated to remove psychic stigmata along with physical deformity. The question of specialization within the specialty (by rhinologists, ophthalmologists, et cetera) must be courageously and liberally faced.

These problems, and many more, constitute a challenge which cannot be ignored. They can be resolved by a farsighted, vigorous policy unencumbered by the shackles of habit or fear of change. Let us hope that the leadership which has carried our organization so well through the difficult period of infancy and childhood will guide its mature years with equal success.

PRESIDENTS 1932–1947

Dr. J. W. Maliniac
(1932–1933)



Dr. J. M. Wheeler*
(1934–1935)
* Deceased 1938

Dr. W. B. Davis*
(1936–1937)
* Deceased 1946

SDr. C. R. Straatsma
(1938–1939)

DR. A. PALMER
(1940–1941)

DR. L. A. PEER
(1942–1943)

DR. G. AUFRICHT
(1944–1945)

DR. E. A. KITLOWSKI
(1946–1947)

APPENDIX

PROGRAMS OF STATED AND ANNUAL MEETINGS 1932-1947

1932

Stated Meeting—June 3, 1932. The New York Academy of Medicine. Chairman, Dr. J. W. Maliniac. Secretary, Dr. Gaston Labat

Leg Lengthening Operation with New Stabilizing Apparatus. Lantern Slides. *Dr. H. Finkelstein*

New Method for Repair of Syphilitic Nose. *Dr. C. Straatsma*

The Use of Physical Therapy in Post Operative Reconstructive Surgery. Motion Picture. *Dr. W. Bierman*

1st Annual Meeting—October 28, 1932. The New York Academy of Medicine.

Plastic Surgery as an Organized Specialty and Problems Confronting It. *Dr. J. W. Maliniac*

Surgical Treatment of Cleft Palate. *Dr. H. S. Vaughan*

Tendon and Nerve Repair in Injuries of the Hand. *Dr. L. Mayer*

Technical Considerations in Plastie Surgery of the Breast. *Dr. Claoue* (Paris)

Radium as an Adjunct to Plastic Surgery of the Head and Neck. *Dr. G. A. Robinson*

The Value of Osteocartilaginous Grafts in Rhinoplasty. *Dr. W. W. Carter*

1933

Stated Meeting—January 30, 1933. New York Hospital and Cornell Medical College. Chairman, Dr. J. W. Maliniac. Secretary, Dr. Gaston Labat.

Reconstruction of Eyebrow Following Radium Burn for Naevus Angiomatosis. *Dr. I. Goldstein*

Repair of Glabella Defect by Dermal Graft. Repair of Saddle Nose by Cartilage Implant. Motion Picture. *Dr. C. Straatsma*

Surgical Repair of Asymmetrical Breasts. Presentation of Cases. *Dr. J. W. Maliniac*

Stated Meeting—March 30, 1933. The New York Academy of Medicine.

Evaluation of Non-Surgical Methods in the Treatment of Cosmetic Skin Disorders. *Dr. Herman Feit*

Bone Carpentry. Lantern Slides. *Dr. Fred Albee*

The Medico-Legal Aspect in the Practice of Plastic and Reconstructive Surgery. *Mr. Lorenz J. Brosnan*

Stated Meeting—May 26, 1933. The New York Academy of Medicine.

Recession of the Levator for Exophthalmos in Graves Disease. *Dr. I. Goldstein*

Cosmetic Results in Electro-Surgery. *Dr. W. Bierman*

Radium Burn of Check Following Treatment for Recurrence of Lymphangioma. *Dr. M. Friedman*

Radium Burn of Face Followed by Insanity. *Dr. C. Straatsma*

Facial Deformities and Abnormalities in their Relationship to Crime. *Dr. Carleton Simon*

The Psychiatric Aspect in the Practice of Plastic Surgery. *Dr. Foster Kennedy*

2nd Annual Meeting—October 16, 17, 18, 1933. New York Academy of Medicine and New York Hospital and Cornell Medical College. Chairman, Dr. J. W. Maliniac. Secretary, Dr. Arthur Palmer

Some Seldom Considered Aspects of Plastic Surgery. *Dr. J. W. Maliniac*

Repair of Deformities of the Eyelids. *Dr. John Wheeler*

Reconstruction of the External Ear. Motion Picture. *Dr. George Pierce*

Total Reconstruction of the External Ear. Original Technique. *Dr. A. G. Bettman*

Arthroplasty of the Jaw. *Dr. Fred H. Albee*

Treatment of Recent Burns. *Dr. F. W. Bancroft*

1934

Stated Meeting—February 16, 1934. New York Academy of Medicine.
New Instruments for Costal Cartilage Resection. *Dr. J. D. Kelly*
Congenital Deformities of the Face—Types Found in a series of One Thousand Cases. *Dr. Warren B. Davis*
Endo-nasal Deformities in Relation to Rhinoplasty. *Dr. G. J. Tieck*
Stated Meeting—May 24, 1934. New York Academy of Medicine.
Congenital Fistula of Septum and Nasal Dorsum. *Dr. Arthur Palmer*
Repair of Coloboma of Upper Eyelid Following Removal of Carcinoma. *Dr. Lyndon A. Peer*
Loss of Upper Lid Margin Following Radium Treatment and Restoration. Epithelioma of left lower lid treated by X-ray. Grafting of conjunctiva cartilage and hair line. *Dr. I. Goldstein*
Illustrative Cases of Corneal Transplantation. (From the Institute of Ophthalmology). *Dr. John Wheeler*
Dermo-fat Graft in Repair of Radium Burn of Face. *Dr. J. W. Maliniac*
3rd Annual Meeting—October 9, 10, 11, 12, 13, 1934. New York Academy of Medicine. New York Hospital and Cornell Medical College. Chairman, Dr. J. W. Maliniac. Secretary, Dr. Arthur Palmer
Criminal Identification with Relationship to Plastic Surgery. *Dr. J. W. Maliniac*
Plastic Surgery of the Lower Urinary Tract. *Dr. Hugh H. Young*
The Use of Osteo-Plastic Flaps in the Repair of Cleft Palate. *Dr. Warren B. Davis*
Reconstruction of the Nasal Tip. *Dr. Claire Straith*
Rhinoplasty for the Hypertrophied Nose. Motion Picture. *Dr. C. Straatsma*
A Clinical Demonstration of Cases of Facial Palsy Operated by Nerve Grafts. *Dr. Arthur B. Duel, Dr. Thomas G. Tickle*

1935

Stated Meeting—June 14, 1935. Atlantic City, New Jersey
Management of Large Skin Flaps. Motion Picture. *Dr. H. Updegraff*
Repair of Facial Defects with Special Reference to the Source of Skin Grafts. Motion Pictures. *Dr. J. W. Maliniac*
Treatment of Angiomas and Pigmented Nevi. *Dr. George Wyeth*
Plastic Operation for Retaining Artificial Eye Following Exenteration of the Orbit. *Dr. I. Goldstein*
Repair of Partial Saddle Nose by Super-Position of the Upper Lateral Cartilages. Motion Picture. *Dr. C. Straatsma*
Simplicity Versus Complicated Methods in Plastic Reconstruction of the Breast. *Dr. Max Thorek*
Plastic Reconstruction of the Anomalous Breast. *Dr. H. O. Bames*
4th Annual Meeting—October 18, 19, 1935. Detroit, Michigan. Chairman, Dr. John M. Wheeler. Secretary, Dr. A. Palmer
Tannic Acid and Silver Nitrate: A Superior Treatment of Burns. *Dr. A. G. Bettman*
Treatment of Burns. Motion Picture Demonstration. *Dr. G. C. Penberthy*
Surgical Treatment of the Different Varieties of Cleft Palate. *Dr. G. M. Dorrance*
Histological Studies of the Fate of the Dermal Graft. *Dr. Lyndon A. Peer*
Comparative Value of Cartilage and Bone Transplants. *Dr. J. Kelly*
Transplantation of the Human Cornea; Its Present Status. *Dr. John Wheeler*
Plastic Repair of Neck Contractures by Tubed Pedicle Flap. *Dr. C. Straatsma*
Plastic Repair of Facial Defects following Treatment for Cancer. *Dr. Hayes E. Martin*
Breast Deformities—Anatomical and Physiological Considerations in Plastic Repair. Motion Pictures. *Dr. J. W. Maliniac*

1936

5th Annuol Meeting—October 30, 31, 1936. Philadelphia, Pa. Chairman, Dr. John M. Wheeler. Secretary, Dr. A. Palmer

Rhinoplasty—Using New Profilometer. (Motion Picture Demonstration). *Dr. C. L. Straith*

An Operation for the Correction of Atresia or Stenosis of the Anterior Nares. *Dr. G. B. O'Connor*

Theories of Etiology of Congenital Deformities. *Dr. W. S. Kiskodden*

The Surgical Treatment of Cutaneous Nevi. *Dr. George Brown*

Surgery, Specialty Surgery and Plastic Surgery. *Dr. V. P. Blair*

Halving Operation in Plastic Surgery About the Eyes. *Dr. John M. Wheeler*

The Restoration of Bone Graft for loss of Bone of the Lower Jaw. *Dr. Fred Albee*

1937

6th Annuol Meeting—October 22, 23, 1937. St. Louis, Mo. Chairman, Dr. Warren B. Davis. Secretary, Dr. G. McAuliffe

Homogenous Thiersch Grafting as a Life-Saving Measure. *Dr. A. G. Bettmon*

Extensive Burn of Scalp—Functional and Cosmetic Results Obtained by Combining Several Types of Skin Grafting. *Dr. W. B. Davis*

Comments on Technique of Keratoplasty. *Dr. R. Costroviejo*

Complications of Rhinoplasty. *Dr. A. Polmer*

Experimental Studies with Cartilage Preserved in Alcohol and Transplanted Beneath the Chest Skin in Humans. *Dr. L. A. Peer*

1938

Stated Meeting—March 24, 1938. New York Academy of Medicine. Chairman, Dr. C. R. Straatsma. Secretary, Dr. G. McAuliffe

Some Complications of Rhinoplasty. (Two Case Reports.). *Dr. C. Strootsma*

Large Protruding or Prolapsed Ears—Anatomical Considerations and Surgical Correction. (Lantern Slides). *Dr. W. B. Davis*

Cineplastic Surgery and Prosthesis. *Dr. H. H. Kessler*

7th Annuol Meeting—November 4, 5, 1938. Philadelphia, Pa. Chairman, Dr. C. R. Straatsma. Secretary, Dr. G. McAuliffe

The Role of the Nasal Septum in Contour Nasal Surgery. *Dr. W. B. Dovis*

Operative Cure of Lupus Vulgaris. *Dr. J. F. Ford*

The Repair of Large Defects following Removal of Skull Bone. *Dr. L. A. Peer*

Plastic Surgery about the Face and Nose. (Motion Picture). *Dr. C. Stroatsmo*

Remarks on the Situation of Plastic Surgery in Europe and South America. *Dr. H. O. Bomes*

Corrective Rhinoplasty—Late Sequelae—their prevention and treatment. *Dr. J. W. Maliniac*

The Plastic Correction of Blepharoptosis. *Dr. E. B. Kirby*

The "Z" Incision. *Dr. J. S. Dovis*

Correction of Short or Retracted Upper Lip. *Dr. G. M. Dorrance*

The Fall and Rise of Plastic Surgery. *Dr. H. L. Updegraff*

1939

Stoted Meeting—January 28, 1939. Hotel Carlyle, N. Y. C. Jaw Reconstruction. *Dr. V. Kozanjian*

8th Annual Meeting—October 27, 1939. Hotel Roosevelt, N. Y. C. Chairman, Dr. C. Straatsma. Secretary, Dr. G. McAuliffe.

Symposium on Skin Grafting. *Dr. J. B. Brown*

A Few Details and Technical Hints in Rhinoplasty. *Dr. G. Aufricht*
Rebuilding the Alveolar Process and the Buccal Sulcus. *Dr. A. G. Bettman*
Blood Supply of the Breast. *Dr. J. W. Maliniac*
The Use of Tubed Flaps for the Study of Healing in Human Skin. *Dr. Leon Sutton*
Mammaplasty. *Dr. G. Aufricht*
The Fractured Nose-Plastic Repair for Deformity and Dislocated Septum. *Dr. J. Maliniac*
Calibrated Skin Graft. *Dr. E. Padgett*
Rib Cartilage Transplant for Saddle Back Nasal Deformity. *Dr. A. Palmer*
Reconstruction of the Nasal Tip. *Dr. C. L. Straith*
Demonstration of the Dermatome. *Dr. E. Padgett*

1940

9th Annual Meeting—October 25, 26, 1940. Chicago, Illinois. Chairman, Dr. A. Palmer. Secretary, Dr. L. A. Peer.
The Development of Plastic Surgery: The need for Improvement in Instruction. *Dr. Arthur Palmer*
Fractures of Maxilla and Use of a New Appliance. *Dr. Milton Adams*
Reconstructive Plastic Surgery in War and Peace. *Dr. G. Aufricht*
Plastic Surgery in Warfare (Lantern Slides). *Dr. J. W. Maliniac*
Problems that Confronted a Plastic Surgeon in this Country During the First World War. *Dr. G. V. Brown*
Marjolin's Ulcer in Burns (Case Presentation. Lantern Slides). *Dr. H. R. Browne*
Experiences in Plastic Surgery during the World War. *Dr. V. P. Blair*
Correction of Facial Paralysis by Muscle Transplant. *Dr. R. J. Alexander*
Compound Injuries of the Face, Mouth and Jaws. *Dr. Earl Padgett*
The Fate of Autogenous Septal Cartilage after Transplantation in Human Tissues. *Dr. Lyndon Peer*
Treatment of Facial Wounds due to Explosions. *Dr. Claire Straith*

1941

10th Annual Meeting—November 7, 8. 1941. Boston, Mass. Chairman, Dr. A. Palmer. Secretary, Dr. L. A. Peer
The Deviated Nose and Its Correction. *Dr. Samuel Cohen*
The Separation of Tubed Flaps with Rubber Bands. *Dr. Edward Kitlowski*
Free Skin Graft vs. Flaps In Surface Defects of Face and Neck. *Dr. J. W. Maliniac*
A Few Details and Technical Hints in Rhinoplasty. *Dr. G. W. Aufricht*
Some Refinements in Reconstructive Surgery. *Dr. Ferris Smith*
Reconstruction of the Ear with the Use of Cartilage Homografts. *Dr. John M. Converse.*
Tattooing of the Cornea with Gold Chloride. Motion Picture. *Dr. Ramon Castroviejo*
Wheeler's Resection of Levator for the Correction of Ptosis. Motion Picture. *Dr. Ramon Castroviejo*
Free Skin Grafts vs. Flaps In Surface Defects of Face and Neck. Motion Picture. *Dr. J. W. Maliniac.*

1942

Stated Meeting—April 17, 1942. Memorial Hospital, New York City. Chairman. Dr. Lyndon A. Peer. Secretary, Dr. E. A. Kitlowski
Repair of Facial Defects. *Dr. Hayes Martin*
Motion Picture Film Illustrating Prosthesis. *Dr. A. J. Ackerman*
Discussion: The cases presented will be selected to resemble defects which might be produced by war injuries. *Dr. Hayes Martin & Assoc.*

11th Annual Meeting—December 4, 5, 1942. Baltimore, Maryland.
Sulphadiazene Treatment of Burns. *Dr. Kenneth Pickrell*
Concentrated Serum in the Treatment of Burns. *Dr. Raymond M. Curtis*
The Treatment of Advanced Carcinoma of the Scalp and Skull. *Dr. Edward Hanrahan*
Construction of Vagina. *Dr. Lawrence Wharton*
Diced Cartilage Grafts. *Dr. Lyndon A. Peer*
The Plastic Repair of Scar Contractures. *Dr. Paul W. Greeley*
Internal Wiring Fixations for Fractures of the Maxilla. *Dr. M. Adams*
Transplantation of Nipples in Mammaplasty. *Dr. M. Adams*
Treatment of a Traumatic Deformity of the Nose and Forehead. *Dr. G. Aufricht*
Some Technical Changes in Rhinoplasty. *Dr. G. Aufricht*
The Use of Periosteal Grafts in Old, Exposed Denuded Bone Areas. *Dr. Neal Owens*
The Use of Celluloid Implants for the Correction of Defects of Contour. *Dr. Neal Owens*
Total Lid Reconstruction. *Dr. Wendell L. Hughes*
Cartilage Implant for Correction of Downward Displacement of the Orbital Contents. *Dr. Wendell L. Hughes*
Shall Plastic Surgery Fail in this War? *Dr. J. W. Maliniac*

1943

12th Annual Meeting—October 7, 8, 9, 1943. Waldorf-Astoria, New York City. Chairman, Dr. Lyndon A. Peer. Secretary, Dr. E. A. Kitlowski
Present Status of Total Ear Reconstruction. *Dr. Lyndon A. Peer*
Total Ear Reconstruction. *Dr. George W. Pierce*
Strategy in Solving Problems of Reconstructive Surgery. *Dr. H. O. Bames*
Total Reconstruction of the Nose. *Dr. Vilray P. Blair*
Reconstruction of Large, Partial and Total Losses of the Lips. *Dr. Ferris Smith*
Reconstruction of the Contracted Eye-Socket. *Dr. Wendell Hughes*
Advances in Plastic Surgery in Latin America. *Dr. H. O. Bames*
The Use of a Single Flap to Restore Extensive Losses of the Middle Third of the Face. *Major A. J. Barsky*
Primary and Secondary Repair of Severed Flexor Tendons of the Hand. *Dr. Sterling Bunnell*
Primary and Secondary Repair of Severed Extensor Tendons of the Hand. *Dr. Condict W. Cutler, Jr.*
Repair for Loss of the Sole of the Foot. *Dr. Thomas Stevenson*
Plastic Repair of Extensor Hand Contractures Following Healed Deep Second Degree Burns. *Lt. Comm. Paul Greeley*
Treatment of Cranial Defects Following Osteomyelitis of the Frontal Bone. *Dr. V. H. Kazanjian*
Skin Grafting in Extensive Acute Burn Cases. *Dr. Earl C. Padgett, Dr. A. G. Bettman, Dr. Jerome P. Webster*
Symposium on Harelip: Management of Double Harelip. *Dr. Warren B. Davis*
Survey of Late End Results in Average Harelip Repair. *Dr. G. M. Dorrance, Dr. J. W. Bransfeld*
Nostril Repair in Wide Harelip. *Dr. H. S. Vaughan*

1944

13th Annual Meeting—October 16, 17, 18, 1944. New Orleans, La. Chairman, Dr. Gustave Aufricht. Secretary, Dr. E. Kitlowski
The Development of Plastic Surgery in the United States. *Dr. Gustave Aufricht*
Total Rhinoplasty Using a Forehead Flap. *Dr. Gordon B. New*
Pedicle Skin Flaps. *Dr. E. A. Kitlowski*

Indications for Determination of the Thickness for "Split" Skin Grafts. *Dr. Earl Padgett*

Problems in Reconstructive Treatment of Gunshot Wound of the Face. *Dr. Michael Lewin*

Organization and Function of the Plastic Service at the San Diego Naval Hospital. *Capt. H. L. Kirkham*

Some Procedures for the Correction of Ear Deformities. *Dr. Jerome P. Webster*

Treatment of Condylar Fractures of the Mandible. *Lt. Comdr. W. M. Adams*

Surgical Treatment of Burns—Use of Pressure Dressings. *Dr. Neal Owens*

Plastic Repair of Selected Facial Injuries Among Naval Personnel. *Comdr. Paul W. Greeley*

Correction of Deformities of the Eye Socket. *Capt. Arthur E. Sherman*

Feature Dislocations of the Cartilaginous Nose. Anatomicopathologic Considerations and Treatment. *Dr. J. W. Maliniac*

1945

14th Annual Meeting—October 11, 12, 13, 1945. Waldorf-Astoria Hotel, N. Y. C. Chairman, Dr. Gustave Aufricht. Secretary, Dr. E. Kitlowski

Recent Advances in Reconstructive Surgery of the Hand. *Major A. A. Barksy*

Teaching Methods in Plastic Surgery of the Hand. (Motion Picture). *Lt. Com. G. V. Webster*

The Effect of Penicillin Applied Locally on the Take of Skin Grafts. *Dr. Hamilton Baxter*

A New Method for Elongating the Columella. *Dr. Claire Straith*

Reconstruction of Contracted Axilla without Grafting (Motion Picture). *Dr. Leon Sutton*

Experimental Observation on the Growth of Young Human Cartilage Grafts. *Dr. Lyndon A. Peer*

Release of Circular Constriction Scar by Z-flap. *Dr. T. W. Stevenson*

Some Pitfalls and Helps in Plastic Surgery of the Palate. *Dr. Thomas E. Carmody*

Early Covering of Extensive Traumatic Deformities of the Hand and Foot. (Motion Picture). *Dr. Jerome P. Webster, Dr. Joseph J. McDonald*

Repair of Avulsion of the Scalp with Split Grafts and Topical Use of Thrombin (Motion Picture). *Dr. Claire Straith, Dr. W. G. McEvitt*

Presentation of a Case of Facial Burns Repaired by Multiple Excision and Z transportation of Flaps. *Dr. Ferris Smith*

Congenital Bands About the Shoulder Girdle. Case Reports. *Dr. A. G. Bettman*

1946

15th Annual Meeting—November 14, 15, 16, 1946. Kansas City, Missouri. Chairman, Dr. E. A. Kitlowski. Secretary, Dr. Lyndon Peer

Arm Amputees, Surgery, Prosthesis, Rehabilitation. *Dr. Henry Kessler*

Nasal Deformities Repair with Free Skin Grafts and with Composite Free Grafts of Skin and Cartilage from the Ear. *Dr. J. B. Brown*

Depressed Defects of the Face. *Dr. Darrel T. Shaw, Dr. John Grotting*

A Button-hole Skin Graft for Extensive Upper and Lower Eyelid Ectropian. *Dr. Jerome P. Webster*

Eyelid Reconstruction in the Blinded. *Dr. S. M. Dupertuis*

Procedures of Practical Value in Rhinoplasty. *Dr. G. W. Aufricht*

Reconstruction of the Nasal Septum. *Dr. W. Steffensen*

Technique of Fine Facial Scars. *Dr. C. R. Straatsma*

The Use of the Masseter Muscle in Effecting Facial Expression Following Complete Paralysis of the Seventh Nerve. *Dr. Neal Owens*

Facial Transplants for Muscular Paralysis. *Dr. Frank Dickson*
Facial Paralysis. Motion Picture. *Dr. James B. Brown*
Anastomosis Between the Ureter and Urinary Bladder by Means of a Subcutaneous Skin Tube. *Dr. A. G. Bettman*
Large Single Pedicle Tube Used to Cover a Defect of the Lower Extremity. *Dr. Darrel T. Shaw*
A Case of Total Ear Reconstruction. *Dr. G. Aufricht*
The Use of Neighboring Tissues in the Correction of an Extensive Facial Deformity. *Dr. W. M. Adams*
Method of Elongating Short Palates—Motion Picture. *Dr. H. A. Baxter*
Tattooing of Dense Corneal Scars. *Dr. K. L. Pickrell*
Various Methods in the Care of Cancer of the Lip. Motion Picture. *Dr. John Erich*

RESTORATION OF THE NOSE, LIP AND MAXILLA BY SURGERY AND PROSTHESIS[1]

VARAZTAD H. KAZANJIAN, D.M.D., M.D.

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Reparative surgery and maxillo facial prosthesis have for centuries been used separately and in an unrelated way for the repair of facial defects and deformities arising from accidents, destructive diseases, and congenital cleft palate. But it is only within recent years that the advantages of combining these two methods have been realized. This point is made especially clear in deformities about the face and jaws when the success of plastic surgery depends among other things, upon the restoration of the normal contour of the region involved. In order to establish that contour we recognize the importance of the underlying framework over which the soft tissues are to be repaired. If bone or cartilage is missing and it cannot be adequately replaced by a plastic procedure, we are obliged to use prosthetic appliances, either as a temporary measure or as a permanent restoration. This point is clearly seen when the teeth and alveolar processes and part of the maxilla are missing. No matter how skillful our plan is in the repair of the lip, unless we supply adequate support from within the mouth, we cannot obtain desirable results in the contour of the lip and cheeks.

Prosthetic restoration of the nose, orbit and other parts of the face has a more limited field and is indicated when surgical methods are inadvisable or impractical. The following case report illustrates the value of coordination of surgery and prosthesis in the treatment of a major deformity of the face.

CASE HISTORY

This forty-one year old patient had an extremely interesting clinical history. He had developed carcinoma of the side of the nose and had been operated upon in April, 1940. Subsequently he had a recurrence of the malignancy, and in 1942 he reported to the Tumor Clinic of the Massachusetts General Hospital for re-examination. There it was found that he had rather extensive recurrent disease in the maxilla and the floor of the nose. It was decided that he should have an extensive operation, which the patient was willing to undergo, and he understood that he would lose most of the upper jaw, the nose and upper lip.

On July 15, 1942 the operation was performed by Dr. Ernest Daland under local anesthesia. Radical dissection of the nose, right maxilla and upper lip was carrier out. The middle half of the upper lip was excised with the diathermy needle and practically the entire nose was removed. The growth on the upper jaw was then thoroughly coagulated, bone removed with rongeur and further coagulation done. Lateral incisions were then made from the upper lip and the lip was approximated.

The patient was seen in the Tumor Clinic on January 21, 1943, when no recurrence of carcinoma was visible. He was referred to the Plastic Clinic at the Massachusetts Eye and Ear Infirmary, where examination revealed the following picture:

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[1] Read at the meeting of the American Association of Plastic Surgeons, Memphis, Tennessee, May 7, 1947.

The greater part of the palate was missing, and the remaining part consisted of the posterior rim of the hard palate with a section of the alveolar ridge. The upper lip was about one-half inch long and was pulled back and adherent to the posterior edge of the palatal perforation. The nose had been completely removed but more tissue had been lost on the left side than on the right (fig. 1).

FIG. 1. PHOTOGRAPHS SHOWING EXTENSIVE DESTRUCTION OF THE NOSE, LIP AND PALATE

After examination a decision was made to carry out the following procedure: Operation to reconstruct the upper lip utilizing the Estlander-Abbe procedure: Construction of an artificial nose and an upper denture.

Prior to operative treatment, however, it was necessary to construct a prosthetic appliance which would act as a support for the upper lip during the contemplated plastic repair. For this purpose an acrylic denture was constructed. The appliance was made in duplicate so that at no time during reconstruction would the upper lip be without the prosthetic sup-

port. From the past experience we have found that even in a well planned operation on the lip, considerable contraction occurs and the required contour and fullness are not obtained unless adequate support is given. The prosthetic appliance acts as an artificial framework in the absence of normal maxillary bone, alveolar process and teeth.

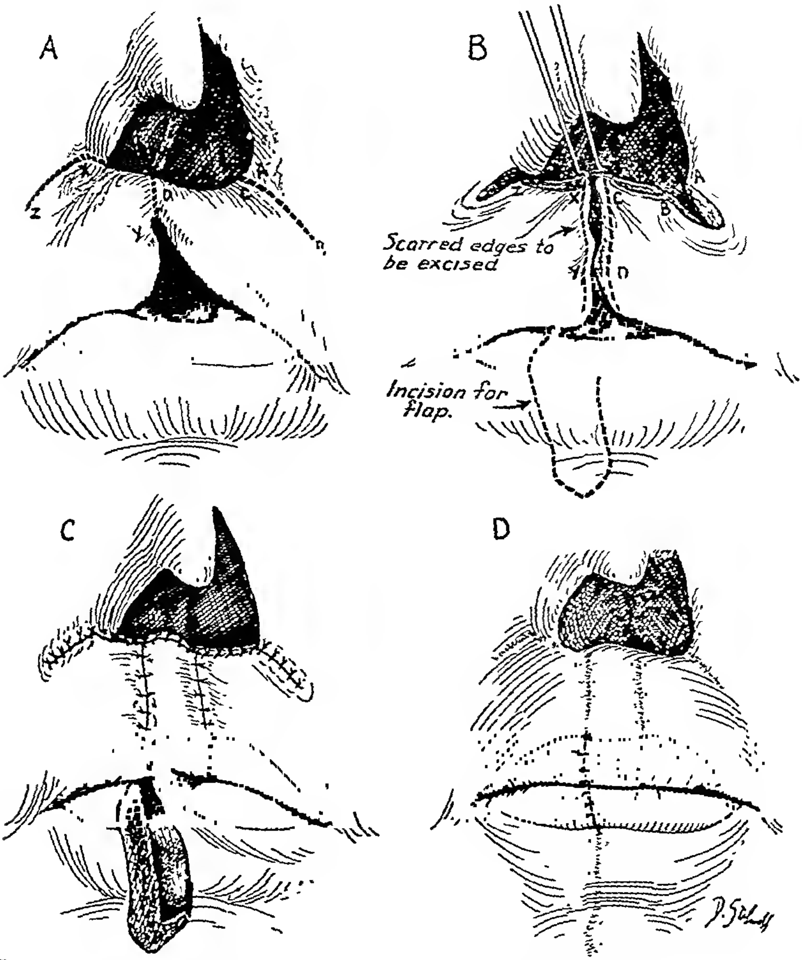

FIG. 2. DIAGRAM OF THE VARIOUS STAGES IN THE ESTLANDER-ABBE OPERATION, FOR THE RECONSTRUCTION OF THE UPPER LIP

On March 13, 1943, the first stage of the Estlander-Abbe operation was performed under local anesthesia. A "V" shaped flap was cut through the median section of the lower lip, leaving it attached only by a narrow bridge of tissue, including the vermilion border. The upper lip was then severed in the midline and the edges freshened. The flap from the lower lip was sutured to the upper lip. The prosthesis for the roof of the mouth was built up with dental compound to form a splint for the support of the upper lip.

On March 29, 1943, the second stage of the Estlander-Abbe operation was performed under

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a b

Fig 5 Photographs Which Show the Repair of the Upper Lip by the Estlander Abbe Procedure

(b) shows the anterior end of the horizontal tube attached to the upper surface of the denture The bar extending from the nose fits into this tube.

Fig 6 Photographs Showing the Artificial Nose in Position

Retention is obtained by the bar and tube attachment to the upper denture, and also by the spectacles

local anesthesia. The pedicle by which the flap transplanted to the upper lip had been nourished was cut, a wedge was removed from the upper lip and the vermilion border was carefully approximated with interrupted Kaldermic sutures. The continuity of the lower lip was likewise restored (fig. 2). The patient withstood the procedure well.

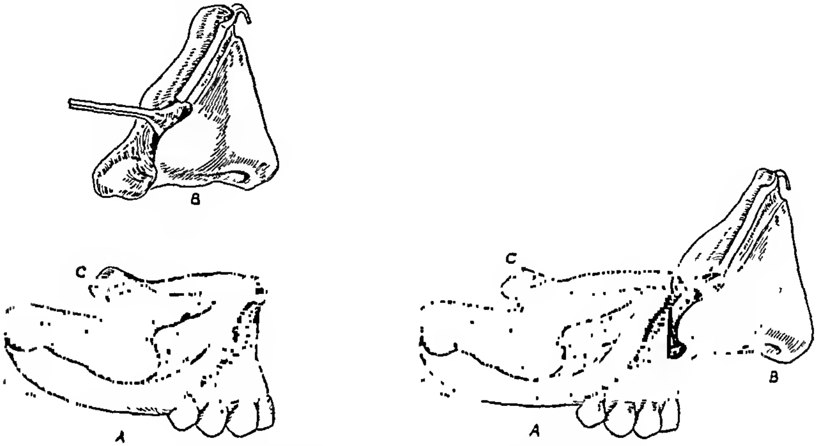

FIG. 3. DIAGRAM OF NASO-PALATINE PROTHESIS

(a) shows the denture which fits over the remaining part of the endentulous palate. Retention is obtained by an extension (c) over the floor of the nose posteriorly, and by a nasal bar and tube attachment which locks the artificial nose to the denture quite securely.

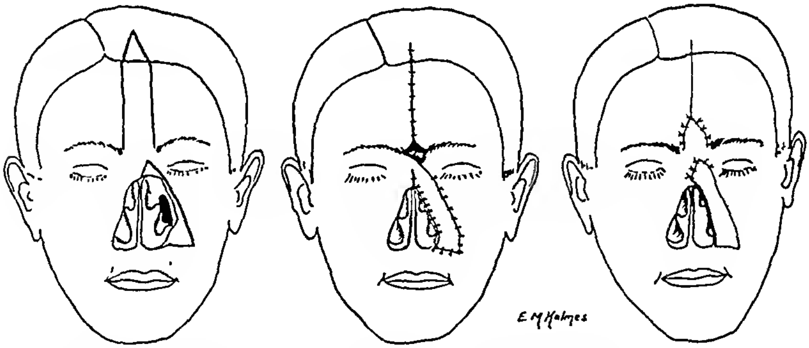

FIG. 4. DIAGRAM SHOWING A MEDIAN FOREHEAD FLAP WHICH WAS USED TO PARTIALLY CLOSE THE LEFT SIDE OF THE NASAL OPENING

When the patient had fully recovered from the surgical procedure, he reported to the Harvard School of Dental Medicine (Surgical Prothesis Clinic) for the construction of a permanent prosthetic nose and an upper denture.

This appliance consisted of an upper denture supplied with teeth. Retention was acquired by an extension of the denture posteriorly and laterally over the perforation into the nasal cavity; (2) by its contact to the upper lip and remaining part of the palate; and (3)

(2) In addition to the palate, and nasal bar and tube attachment, the artificial nose is supported by the frames of spectacles with a special attachment from the frame to the arm extending over the ear. Another function of the spectacles is to conceal the line of demarkation between the prosthesis and the surrounding skin of the face.

In the construction of artificial noses I have preferred the use of acrylic material or vulcanite rubber because when a solid substance is used it allows for the construction of efficient supporting attachments. These substances are painted satisfactorily with a celluloid type paint.

In this case the upper lip was reconstructed by the Estlander-Abbe procedure in preference to having the prosthetic restoration extend over the lip.

by a special attachment at the upper part of the denture to which the artificial nose was fastened. This attachment consisted of a square tube about 3 mm. in diameter, fastened antero-posteriorly above the floor of the nose (fig. 3).

The artificial nose was made of hard acrylic and held in position by (a) its contact to the borders of the amputated nose; (b) by the bridge and frames of the spectacles which fitted accurately to the borders of the nasal opening, supplemented by "U" shaped clasps which held the bridge of the spectacles firmly; and (c) by a square horizontal wire about 3 mm. in diameter extending backward from the back of the artificial columella of the nose. This square wire bar fitted into the tube on the upper surface of the denture.

The patient used this prothesis very satisfactorily for over a year, but because of the extent of the nasal operation the edges of the artificial nose could not be concealed by the frames of the spectacles. As a result it was quite evident that the patient was wearing an artificial nose. Therefore, it was decided to reduce the space on the left side by adding some skin tissue to be taken from the median section of the forehead. The operation was carried out in two stages, under local anesthesia (fig. 4). This procedure greatly improved the appearance of the artificial nose and the conspicuous portion that extended toward the left side of the face was completely eliminated.

The patient has been able to wear the appliance with ease and satisfaction since the major operation for the removal of malignant disease in July 1942. There has not been any further recurrence of disease, and his morale and mental attitude has completely changed, allowing him to carry on his normal business pursuits as a salesman (figs. 5 and 6).

I would like to make a few remarks on the relative merits of the surgical and prosthetic approach in the correction of maxillo-facial deformities, especially those following operative treatment of malignant tumors.

In undertaking reconstruction of the face it has been my rule to give the patient the benefits of surgery whenever possible. However, the patient's physical condition, local condition of the tissues, as well as other factors must of course be taken into consideration before reconstructive surgery is begun. In cancer cases, surgical procedures cannot replace destroyed tissues of the palate and alveolar ridges which are necessary for the efficient use of artificial dentures. Hence we must supplement surgery with prosthetic measures as exemplified by the foregoing case.

In this case plastic reconstruction of the entire nose could have been accomplished, and supplemented by prolongations of the artificial denture extended under the reconstructed nose to act as a framework. There were two objections to such a procedure: (1) We were not positive that the patient would not have a recurrence of carcinoma; and (2) the wearing of an artificial nose allowed for frequent inspection of the involved area and if there was a recurrence it would be detected early. It was possible to make an artificial nose that conformed more readily to the normal nose and this could not have been so easily accomplished by surgical procedure.

An artificial nose must be made according to certain mechanical as well as artistic principles.

(1) It must fit securely on the face. When the artificial nose has a connecting attachment to the denture (as in this case) maximum stability is acquired, not only of the nose but also of the denture. In this case the denture had no means of stability except for a small section of edentulous hard palate.

has substituted tantalum wire and thin sheet tantalum saddles in place of fascia lata as the suspensory material. Briefly, his technic consists of passing small gauge tantalum sutures through a flexible infiltration needle which has been previously placed subcutaneously among the course which it is desired the supporting elements should lie. These wires are then attached medially to small tantalum sheet saddles surrounding the muscle bundles just over the midline on the unaffected side of the face. Traction is made upon these wires until sufficient correction of the sagging paralyzed tissue has been obtained and this correction is then stabilized by tying these wires laterally to similar tantalum saddles which have been placed about the temporal fascia and muscle. The advantages claimed for this method are: "1. The operation is performed under local anesthesia. 2. No disability or bed rest is necessary for the patient, as no incision is made for the removal of fascia from the thigh. 3. When the wires are in position, the patient can sit up and the wires can be tightened to the proper tension, thereby doing away with the amount of sagging in the paralyzed side which occurs when the patient is lying down. 4. There is no swelling or hemorrhage in the tissues of the paralyzed side because of the very slight trauma which is produced by the small caliber of the local needle." (1).

These advantages which have been cited prompted us to utilize Schuessler's method in the repair of two cases of facial paralysis.

While our experience with Schuessler's technic has not been extensive, we have encountered one basic difficulty involved in the permanent correction of facial paralysis by the tantalum wire saddle method, namely, the marked tendency of the saddles to cut through the muscle bundles about which the saddles are placed, regardless of their width. The inadequate facial correction obtained in Case 2 was in part attributable to this difficulty. One other deformity and disability produced by a complete facial paralysis which is not materially benefitted by the foil saddle mode of repair is the inclination toward ballooning out of the paralyzed cheek when the enunciation of syllables requiring expulsive effort on the part of the cheeks is attempted. This situation is undesirable cosmetically and interferes with clear speech. A more clearcut example of the hardship which this uncorrected disability may entail may be found in the case of those individuals with facial paralysis who must wear dental plates. These patients, due to the flaccidity and atrophy of the paralyzed cheek, often have difficulty in maintaining their denture in position since the action of the musculature of the unparalyzed cheek acts to force the denture toward the paralyzed side and loosening its contact with the alveolar ridge. Other patients have difficulty to keep from biting their paralyzed cheek. Thus mastication may be made difficult or impossible.

The recent manufacture of tantalum gauze and its use in the repair of large hernial defects by several men (9) suggested to us a means of overcoming both the cutting effect of the saddles and the flaccidity of paralyzed cheek muscles. We believe that if moderately large segments of tantalum gauze are implanted in the facial tissues the surrounding fibrous bands of tissue growing through the mesh will allow a more equitable distribution of the pull placed upon them by a tantalum wire suspension than would a similar pull placed upon the small

THE TREATMENT OF FACIAL PARALYSIS BY TANTALUM WIRE SUSPENSION

Preliminary Report[1]

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The advent of new drugs, metals and plastic materials is constantly simplifying the technic and improving the results of many reconstructive procedures. Typical of such improved results are the case reports here presented concerning the repair of facial paralysis using a modification of Schuessler's (1) tantalum wire suspension technic, employing sheet tantalum saddles, also the authors' technic with tantalum gauze. These reports are presented primarily to add to the growing fund of knowledge of the use of tantalum in the field of plastic surgery.

The frequency of injury to the facial nerve and the tragic deformity which results has provoked many to devise schemes whereby this disability might be minimized. In 1913 Busch (2) and Momberg (3) attempted the mechanical suspension of paralyzed facial muscles by the use of aluminum-bronze wire, one end of which was looped about the facial muscle bundles and the other looped about the zygoma, tightened, and tied when the optimum facial correction had been obtained. This early operation was found to be unsuccessful because of failure to adequately counterbalance the action of the non-paralyzed muscles on the opposite side, the unfavorable local effect of a not completely inert foreign body in the tissues, and the tendency of the aluminum-bronze wires to disintegrate. The unsatisfactory results obtained from wire suspension at that time led Stein (4) to use free fascia as the suspensory material since its use provoked no foreign body reaction, it rapidly became one with the facial tissues, and since fascia lata has no tendency to break or cut through the enclosed muscle bundles, it has been used extensively. In recent years, Blair (5, 6) has advocated a modification of this original technic in which multiple suspensory loops of fascia are interwoven laterally into the parotid and preauricular fascia Gillies (7) has advocated the attachment of suspensory loops laterally to the temporalis muscle so that contraction of this muscle will transmit some pull upon the paralyzed facial musculature. Numerous other modifications of the fascia suspension technic have been proposed with varying degrees of success (8) yet all possess certain disadvantages, among which may be cited: the presence of hemorrhage and swelling of the face incident to the operative manipulation of the fascia carrying instruments, the increased likelihood of infection due to the operative trauma, and in many cases the performing of an additional operative procedure to obtain fascia from the thigh. Schuessler (1), with the view of obviating these difficulties, has recently reported upon the use of tantalum wire to repair facial paralysis. He has advocated the Gillies type of suspension but

[1] From the Department of Surgery, University of Illinois College of Medicine, Research and Educational Hospitals and the Presbyterian Hospital of Chicago

This is done by tying the suture to the finger-like portions of screening, which has been previously wired to the larger portion of screening and then the entire assembly is drawn into position by making a slight tension on the silk suture (fig. 1). This three piece assembly of tantalum gauze in the upper and lower lip and cheek is allowed to remain in the soft tissues for a period of two months before deciding on the final degree of suspension. Many fibrous bands grow through the gauze mesh firmly fixing these tissues in their proper relation. Frequently the mere insertion of the tantalum gauze mesh is adequate to support the tissues in their

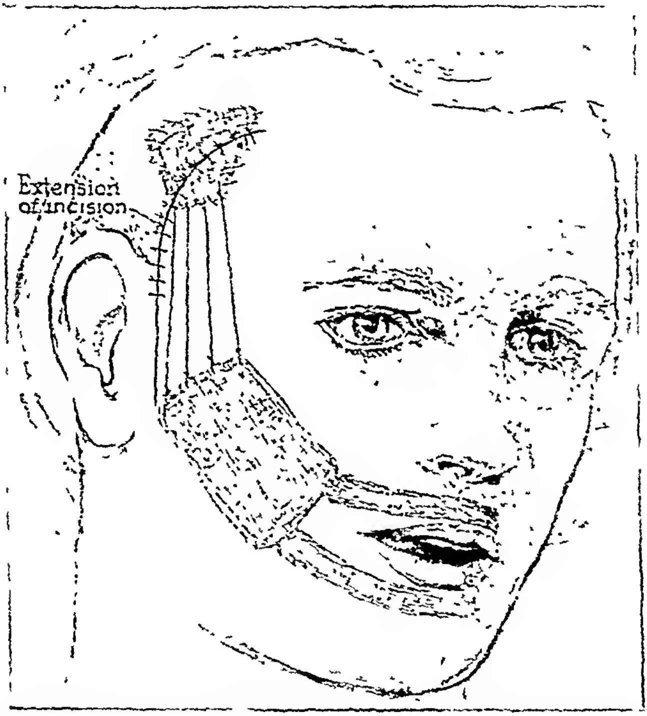

FIG. 2. SECOND STAGE CORRECTION OF 7TH NERVE PARALYSIS BY SUBCUTANEOUS IMPLANTATION OF TANTALUM GAUZE SUTURED TO THE TEMPORAL FASCIA WITH BRAIDED TANTALUM WIRE

normal balance. When this is not sufficient to elevate the tissues to their normal level, tantalum wires are placed through the superior-lateral margin of this gauze and connected to tantalum gauze placed over the temporal fascia which was previously anchored to the *fascia* by suturing with braided tantalum wire (# 3-0). The incision is closed with 6-0 nylon interrupted suture (fig. 2). A small waste pressure dressing supported by an ace bandage is then applied for the subsequent 48 hours to control postoperative oozing at the site of gauze wire implantation. The avoidance of facial activity for several days postoperatively is advisable to

amount of tissue enclosed by a tantalum saddle. Such an implanted gauze of tantalum wire will, if made sufficiently large and accurately placed, also lend support to the atrophic cheek and will aid in prevention of the ballooning out effect already described and the unwelcome mobility of the dentures. Therefore when the technic of Schuessler failed, in our hands, to afford a satisfactory result, the following operative procedure was devised to utilize the advantages offered by the use of tantalum mesh gauze. Using morphine sulfate gr. $\frac{1}{4}$ and

FIG. 1. FIRST STAGE CORRECTION OF 7TH NERVE PARALYSIS BY SUBCUTANEOUS IMPLANTATION OF TANTALUM GAUZE

For purpose of clearness, the pattern of the tantalum gauze is shown as if it were on the surface. Actually it is subcutaneous and would be invisible.

scopolamine grains $\frac{1}{150}$ for sedation and 1% novocaine as a local anesthetic, a vertical incision is made in the pre-auricular area and by blunt and sharp dissection the skin of the cheek is undermined down to the corner of the mouth and a narrow pocket formed in the upper and lower lip extending beyond the midline. In this cavity is placed a roughly oval segment of tantalum wire gauze 4 by 6 cm. with 2 finger-like projections 1 cm. by 5 cm. A needle with a silk suture is passed through the distal or deepest portion of the pocket in the upper lip and one in the lower lip which will facilitate drawing the wire mesh into its proper position.

November 27, 1944, two tantalum saddles were placed near the medial and lateral end of the left eyebrow, and one at the hair line; these were connected by tantalum wires producing an elevation of the left eyebrow to its normal position. The skin incisions were closed with 6-0 nylon. The postoperative management and course was similar to the previous operation and was equally uneventful, the patient leaving the hospital on the third postoperative day.

Over a period of time the sagging of the tissues due to insufficient support made it necessary to insert tantalum gauze screening through an incision in the cheek making a pocket subcutaneously large enough to admit a piece of tantalum gauze in the upper lip, a piece in the lower lip, and a piece in the cheek; the lip sections being wired to the cheek section. This was allowed to heal in position giving the tissues the necessary support to be well balanced with the opposite side. This operation was performed on April 9, 1945.

Case 2. W. G., a 17 year old white male, entered the Illinois Research and Educational Hospital on Oct. 12, 1944 because of a left facial paralysis of ten years duration.

FIG. 3. BEFORE AND AFTER EXPRESSION AFTER THE INSERTION OF TANTALUM GAUZE IN THE LIPS AND CHEEK

Notice correction in nasal deviation

The patient's history disclosed that following a mastoiditis when 8 years old, this patient developed a severe infection in the left preauricular area involving the maxilla and mandible which later resulted in a facial paralysis, the extrusion of several sequestra from this area, and a fibrous ankylosis of the temporomandibular joint. At this time it was felt that no reconstructive surgery should be attempted because of the youth of the patient. However, in 1940 and again in 1941 attempts were made to loosen the ankylosis by wedging the teeth apart with tongue blades under general anesthesia, but the results obtained were only of temporary benefit. In 1944, believing that more radical measures offered the only hope of lasting improvement, an arthroplasty of the left temporomandibular joint was done which permitted free motion of the jaw.

On admission, a physical examination revealed a left facial paralysis which was evidenced by an inability to tightly close the left eye, to elevate the corner of the mouth, to wrinkle the forehead, and to accomplish facial movements requiring muscular balance such as whistling. A scar in the left preauricular area, marking the site of previous surgery and

prevent the accumulation of blood or serum in the facial tissues and to aid in wound healing. For this reason, feeding is done by means of a spout cup for the first few days postoperatively. The presence of a normal bleeding and clotting time and adequate protein level and an adequate intake of vitamin C, together with careful hemostasis will aid in obviating this complication. The possibility of infection at the sites of wire implantation is extremely remote and to date there has been none. Contamination, however, could be controlled by the use of sulfonamide or penicillin therapy if necessary. The sutures may be removed from the skin in 3 to 7 days. The tantalum gauze sewed to the temporal fascia with braided tantalum wire will stand the stress of holding the gauze in the cheek immediately and may be snubbed up to obtain the desired degree of facial symmetry. It is noted that by this method the ability to subsequently readjust relaxation of the tissues by simply tightening the wires through the old incisions is still retained. However, this has not been necessary to date.

The following case reports will illustrate our experiences both with Schuessler's technic as well as with our own modification of his method in the repair of facial paralysis.

CASE REPORTS

Case 1. A. B , a 65 year old white female entered the Presbyterian Hospital on Nov. 15, 1944, because of a paralysis of the left side of the face.

The patient's past history revealed that she had had a hypertension of five years duration and that 10 years ago she had suddenly developed a paralysis of the left side of the face. The deafness in the left ear was accounted for by recurrent attacks of left otitis media which had resulted in complete deafness in childhood. The remaining history was non-contributory.

Physical examination revealed the following relevant findings: examination of the face disclosed a complete left facial paralysis which had produced an absence of facial expression, sagging of the tissues, and an inability to tightly close the eye on this side. The disturbance of muscular balance produced by this paralysis caused a drawing of the face toward the right with distortion of the features which was most obvious when the patient smiled. Examination of the body showed a spastic paralysis of the right arm and leg. Other findings included a sclerotic left tympanic membrane which was also punctured, a complete 7th nerve paralysis, and anodontia. Evidence of hypertension was born by a blood pressure of 169/110, a heart enlarged to the left, as well as moderately advanced arteriosclerotic retinopathy. Blood counts, bleeding and coagulation time were within normal limits.

On November 16, 1944, under local anesthesia with preoperative sedation consisting of nembutal gr. iss, morphine sulfate gr. $\frac{1}{4}$ and atropine sulfate gr. $\frac{1}{150}$, an attempt was made to balance the unparalyzed right facial muscles by the implantation of two tantalum saddles just over the midline on the right side of the face beneath the lower lip, two above the upper lip just over the midline, and a fifth near the left angle of the mouth. These saddles were connected by tantalum wires to three more saddles placed in the temporal fascia and muscle, emplying Schuessler's technic. These wires were then tightened when the optimum facial correction had been obtained. The redundant skin was then excised and the wound closed, using a 6–0 nylon Halsted intradermal suture (fig. 3).

Postoperatively, the patient was placed on a ward diet and was allowed to be ambulatory. The freedom of the operative sites from hemorrhage necessitated no pressure dressings so that the suture lines were kept free of crusts with boric acid swabs The postoperative course was uneventful. However, it was felt that placing two additional supporting wires to elevate the ssgging left eyebrow would further improve the cosmetic result. Hence, on

FIG. 4. TANTALUM GAUZE INSERTED IN UPPER AND LOWER LIP AND CHEEK
Fan shaped piece of tantalum gauze sewed to temporal fascia with three suspending wires attached to gauze in cheek

FIG 5 FRONT VIEWS BEFORE AND AFTER INSERTION OF TANTALUM GAUZE SCREENING

x-rays, revealing an absence of the left temporomandibular joint, completed the pertinent findings.

Since it was felt that a repair of the left facial nerve was not feasible, on October 20, 1944, an attempt was made to suspend the paralyzed facial musculature using Schuessler's tantalum wire technic. Using morphine sulfate, grains $\frac{1}{4}$ and scopolamine, grains $\frac{1}{150}$ for sedation and 1% novocaine as the local anesthetic agent, an incision was made in the hair line of the left temporal area and carried down in the preauricular region to curve behind the ear. The temporal fascia was exposed and three tantalum saddles were placed, connected by tantalum wire; four similar saddles were placed about muscle bundles just over the midline of the face in the upper lip, near the left angle of the mouth and lower lip through small skin incisions. These wires were then tightened until the optimum correction of the facial deformity was obtained, the redundant skin produced by tightening of the relaxed facial musculature was removed from the anterior edge of the preauricular incision and all skin incisions were closed with 6–0 nylon Halsted's intradermal suture.

Post-operatively, the patient was permitted to be ambulatory and to eat a ward diet. As a precaution, a pressure dressing was applied to the face for the first forty-eight hours. The post-operative course was uneventful and the patient left the hospital on the third postoperative day. Skin sutures were removed in 7 days.

Five months following this operation, it was noted that some of the original facial deformity had returned. This appeared to be due to failure at the original operation to place the tantalum wires in a straight line which had resulted in relaxation of the facial tissues as the wires in response to tension gradually straightened and simultaneously loosened. Some of the recurrence is attributable to the tendency of the tantalum saddles to cut through or cause atrophy of the muscle bundles they surrounded which would also permit relaxation of tension. It was, therefore, deemed advisable to recorrect this deformity by exposing the tantalum wire and tightening the same. This has been done and the facial symmetry restored.

On September 7, 1945 this patient was readmitted to the hospital because the previous implantation of tantalum saddle suspension had failed to adequately correct his facial deformity, due to relaxation of the wire and muscular power causing a cutting through of the tantalum saddles. At this time, therefore, under 1% novocaine local anesthesia an incision was made in the old scar line in the preauricular area on the left side and the left cheek as well as a portion of the right cheek just over the midline was undermined to allow the implantation of plaques of tantalum gauze mesh as described in the case previously presented; these incisions were then closed with a 6–0 nylon intracuticular suture and a pressure dressing was applied. The patient was discharged from the hospital three days later after an uneventful postoperative period. Following the removal of these sutures ten days later, the patient was temporarily dismissed to allow time for healing and the ingrowth of fibrous tissue into this meshwork.

On February 14, 1946 the patient was readmitted to the hospital and under local anesthesia through the previous incision the tantalum wires connecting the tantalum gauze plaques to the mesh saddles placed in the temporal fascia were tightened until a slight degree of overcorrection of facial expression was obtained. The wound was again closed with 6–0 nylon and a pressure dressing applied. The x-rays (fig. 4) illustrate the position of the gauze mesh and wire following this procedure and the accompanying photographs demonstrate the cosmetic result obtained. Subjectively the presence of these foreign bodies in the cheek have caused the patient no discomfort nor functional disability (fig. 5).

Case 3. M. W., a 53 year old white female, was admitted to the Research and Educational Hospital on November 11, 1945, because of a complete left facial paralysis which had resulted from the radical removal of a recurrent mixed tumor of the left parotid gland which had infiltrated the facial nerve. In addition to complete paralysis of the left facial musculature, this patient complained of difficulty in wearing her dentures and inability to keep from biting her left cheek, due to flaccidity of the musculature of this cheek. On

The patient was readmitted to the hospital in February 1946, for the insertion of a fan shaped piece of tantalum gauze about 3 cm. on each side, made of .005 wire and 50 wires to the inch. This was placed directly over the temporal fascia and sewed to the same with #3-0 braided tantalum wire, making a very firm anchorage for the three wires running down to the finer mesh gauze implanted three months previously.

The patient made an uneventful recovery with a well balanced facial expression.

SUMMARY

In our experience, the tantalum wire suspension technic does possess certain distinct advantages, some of which will bear elaboration. This operation provides a relatively simple means for adequately counterbalancing the facial muscle pull of the unparalyzed side to a fine degree not only by varying the tension placed upon the requisite number of implanted tantalum wires, but also by varying the position and size of the tantalum gauze plaques to be buried. It is a definite advantage to be able to provide further correction of recurrent deformity due to subsequent relaxation at a later date by merely tightening these tantalum wires through a small incision under local anesthesia in the hair line at their point of attachment to the saddles placed in the temporal fascia. Since fascia stripping becomes unnecessary and since the operative trauma to the face is slight, the possibility of shock is largely avoided and infection made infrequent particularly if prophylactic sulfonamide or penicillin therapy is utilized. The ability to do all manipulation under local anesthesia yet without causing the patient discomfort has simplicity to recommend it to which may be added avoidance of the dangers of post operative pulmonary complications inherent in any general anesthesia. Certainly, early postoperative ambulation and the ability to talk and eat soon after surgery made possible by this method recommends itself to the patients. From a purely mechanical standpoint, the use of tantalum wire is an advantage since it produces no foreign body reaction; it is easier to work with than fascia; wires of any desired strength may be employed with only a slight increase in size; and finally, the position and condition of these supporting wires can be easily determined by an x-ray of the patient's face.

Several disadvantages of the wire suspension technic require mention. Obviously, the suspension of paralyzed muscles cannot produce a result comparable to that produced by a repair of the facial nerve which adequately reinnervates the paralyzed facial musculature, for though marked facial deformity has been removed, normal facial motion and expression is impossible. Caution must be exercised that neither the tantalum wires nor wire gauze are placed so close to the skin or mucous membrane that motion or irritation might cause them to be extruded. Care must also be taken that the pull of the tantalum wire supporting the facial musculature is well distributed either by the inclusion of a large amount of tissue by tantalum foil saddles or, as we prefer, by the utilization of segments of tantalum gauze. The necessity for a straight course for the supporting tantalum wires is of equal importance in the prevention of this complication. Suspension of the paralyzed muscles alone is often but one of several plastic procedures which may be required to produce the optimum cosmetic

November 13, 1945 tantalum mesh gauze made of 003 wire—100 to the inch, was inserted into the cheek and lips as in previous cases and allowed to become encysted with fibrous

Fig. 6

connective tissues. The x-rays subsequently taken (on Nov. 13, 1945) show the relationship of the tantalum wires in relation to the upper and lower jaws.

FREE SKIN GRAFT

Immobilization with Plaster[1]

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Surgery recognizes that postoperative immobilization is indispensable for the perfect results with grafts, whether they be of fat, tendon, nerve, fascia, bone, etc., and also recognizes that tbis technical exigence is more strict when dealing with the free skin graft.

In this case immobilization must be exact, that is to say, a close contact has to be maintained between the cutaneous transplant and its receptor bed. The immobilizing element should *maintain* the graft against the bed without *pressure*, so as not to interfere with the local circulation. A certain degree of compression is admissible, and necessary to prevent accumulation of a serohematic exudate, which, when formed between the bed and the transplanted skin favours necrosis of the latter and infection of the bed.

Immobilization must be uninterrupted (2–3 weeks) during all tbe process of vascular neoformation from the bed to penetrate and give life to the graft.

The immobilization must be evenly distributed. To attain this the substances used must be easily and quickly adaptable to the morphological depressions and prominences of the various anatomical regions. On tbe other hand, sea sponges, cotton wool bandages and pneumatic bags that different plastic surgeons use to immobilize the transplants tend to exert more pressure on the prominent places, while the bandage is adapted firmly.

The immobilization with plaster must be extended a considerable distance from the operated zone, so as to obtain a greater fixedness. Therefore, when we want to graft the band, we previously make a plaster cast that immobilizes the hand at the same time as the forearm and half of the arm, leaving the elbow at a right angle (Case III). In the case of a graft on the foot, we previously apply a plaster cast that includes foot, leg and inferior third of the thigh, leaving the knee in slight flexion (Case IV).

We have been using this method for ten years (1) and the cases and illustrations give an idea of the technique that we follow in adapting the plaster to the various regions operated on.

SUMMARY

Free skin grafts must be perfectly immobilized against the receptor surfaces. Immobilization must be *maintained* without *pressing* the graft against the bed; it must be evenly distributed no matter what the morphological configuration of the grafter part; it must be uninterrupted for 2–3 weeks. For this the plaster cast is a simple and efficient immobilizing element.

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[1] Part of this work was presented to the XVII Argentine Congress of Surgery, Buenos Aires, 14–18, X, 1946.

result. An associated face lift, which was performed in two of these cases, may be helpful as well as other plastic efforts as the individual case demands.

Despite the limitations of tantalum wire suspension of facial paralyses, we believe that it is an operation which has a place in the treatment of irreparable damage to the facial nerve as a result of partial or complete destruction of the facial nerve or inadequate innervation following facial nerve anastomoses. The use of tantalum gauze saddles and tantalum wire would also seem to be of value as an adjunct of primary and delayed facial nerve anastomoses in the prevention of stretching of the denervated facial muscles while regeneration is occurring. The mere insertion of tantalum gauze in the lips and cheeks offers enough support in many cases, making it unnecessary to run supporting wires to the temporal fascia.

The passing of the tantalum gauze strips over the *entire* upper and lower lips is also beneficial because it moderates the action on the normal side and supports the inactivated side, thereby bringing the two sides more symmetrical in action.

The choice of heavy or light wire, braided or solid wire, large or small saddles, 50 or 100 mesh gauze of any design easily manipulated all favor this technic.

Tantalum monofilament wire has been used in many cases for skin closure with very good results. The best closure is made with a regular double twist as in the surgeon's knot and cutting both ends before the locking knot is placed on top. The ends of the suture lay flat on the surface and support the skin edges perfectly.

Other beneficial uses for this material have been found in the eradication of frowns, wrinkles, sagging or relaxed skin, raising lower eye lids for a correction of the palpebral fissure or supporting an upper lid to correct a ptosis.

In no case in our limited number has it been necessary to remove the tantalum nor has there been a tissue reaction or pain.

Tantalum gauze is now available in .003 wire 40 x 40 mesh for all who want it.

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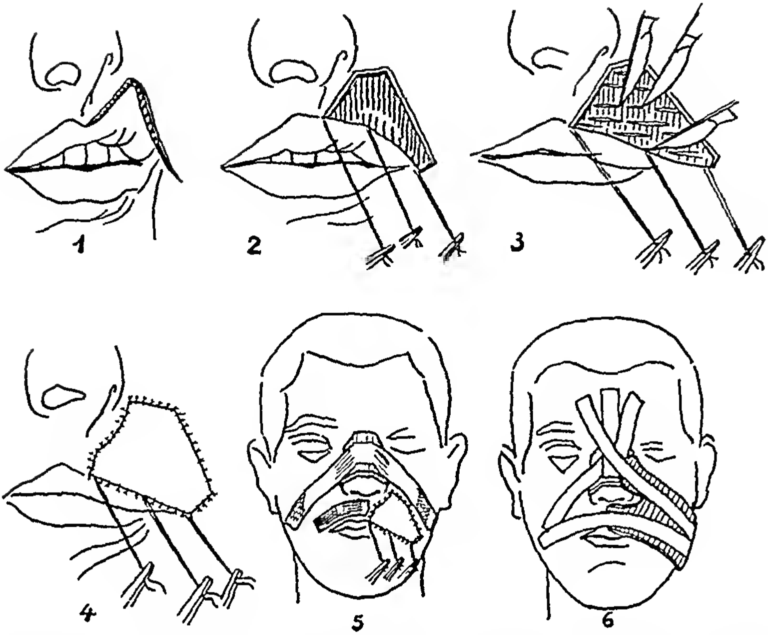
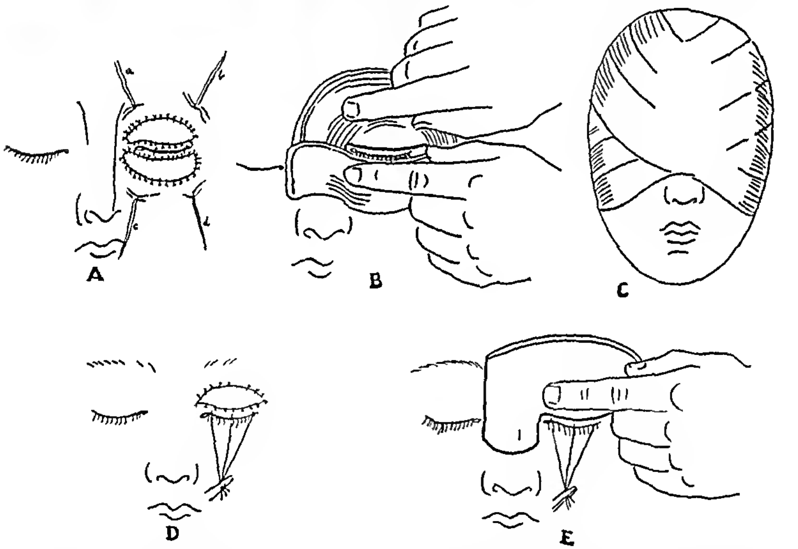
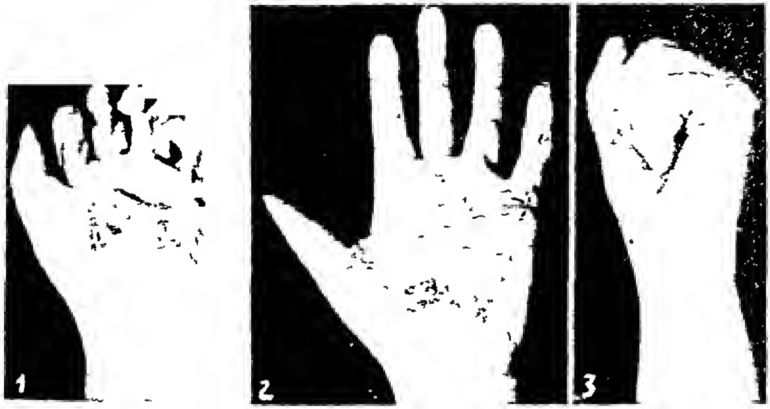


Case I FIG 4 1, Upper left, 2, upper center, and 3, upper right Incision that liberated the ectropic border of the labial mucosa Three temporary stitches draw the lip and the commissure down and outwards, while the knife sections the cicatricial bands appear tense 4, lower left Sutured cutaneous graft 5, lower center, and 6, right The nasal pyramid is moulded with plaster and once it is hard, the plaster splint is fixed with adhesive tape The graft is covered with a hemmed gauze on which a plaster splint is applied that is unified with the nasal plaster The plaster adapts and immobilizes the operative region, fixing the soft parts against the maxillary and gingivolabial skeletal plane The patient should leave the lip at absolute rest, be on soft diet, and speak only between the teeth (This operation is not advisable on indocile children)

Case I Fig 1 (Left) Ectropion of eyelids and of the left upper lip, following burn
Fig 2 (Right) Result obtained with four free skin grafts and one eyebrow graft

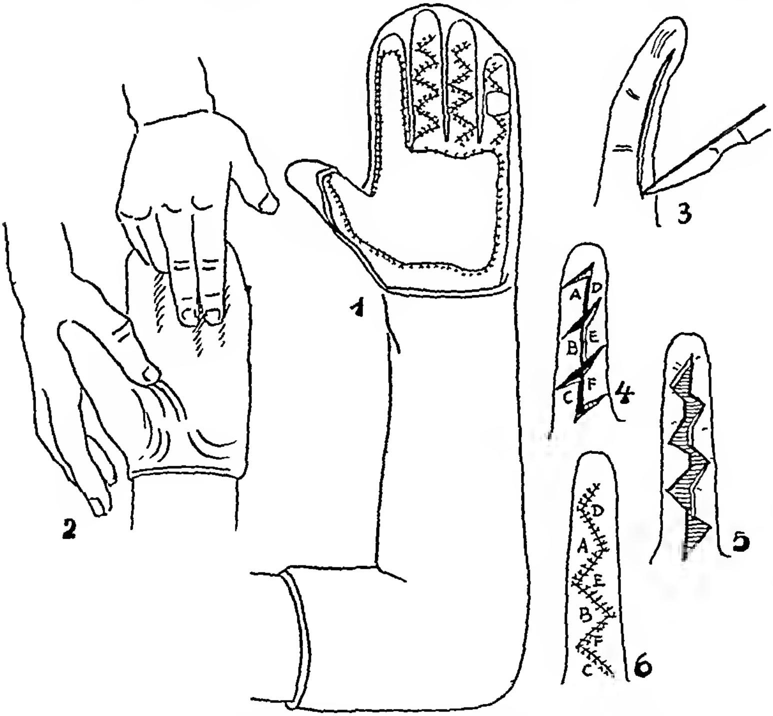


Case I Fig 3 A, upper left Once the eyelids are surgically liberated, the ciliary borders are sutured temporarily with three interrupted stitches Four tractor cutaneous stitches are applied (a–a–c–d) so as to maintain well stretched the surfaces to be grafted The grafts are taken from the auriculomastoid region The sutured grafts are covered with a moist hemmed gauze B, upper center We apply two plaster splints that are joined at their extremities, forming thus only one piece The palpebral commissure is left exposed The plaster is modelled over the eyelids, being applied to the ocular surface and to the orbital border When the plaster has hardened, the four tractor stitches are withdrawn C, upper right The palpebral commissure is covered with cotton wool and the whole of it is bandaged It is best that during the first two days both eyes should be included in the bandage, so as to give the greatest possible relaxation to the operated zone D, lower left, and E, lower right When only one eyelid is grafted the three sutures in the ciliary borders are used to stretch the surface that will be grafted We leave the plaster dressing untouched for 2–3 weeks if no complications arise The longer the immobilization, the better the results of the graft will be

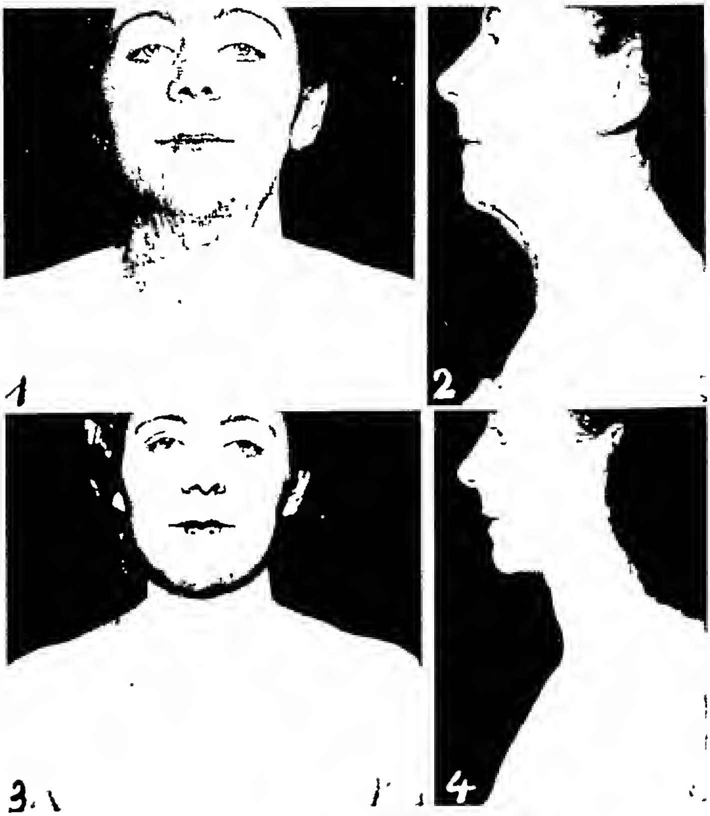


CASE III

FIG. 1. Digito-palmar retraction caused by burn
FIGS 2–3 Results obtained with a free graft which includes the palm, the first interdigital commissure and the palmar face of the thumb and index The bridles of the three last fingers were treated by Denonvilliers-Morestin's procedure. In the little finger it was necessary to add a small graft to complete the closure of the breach.

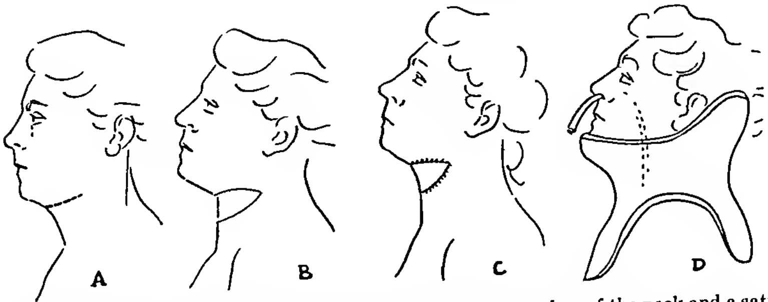


Case III FIG 4. 1, We apply an unpadded plaster cast, the day before the operation. A window is then made, exposing the part to be operated on 2, The plastic operation done, the field is protected with a moist hemmed gauze and covered with a plaster splint of a soft consistency, so as to permit an easy palmar and digital adaptation, and also its perfect modelling especially in the first interdigital space. This splint extends beyond the limits of the other plaster, forming thus one piece. 3, 4, 5, 6, Stages of Denonvilliers-Morestin operation.

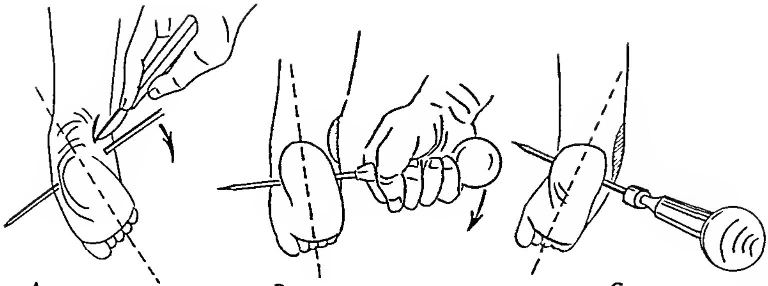


CASE II

PHOTO 1–2. Scar that limits the chin excursion and effaces the mento-cervical curve.
PHOTO 3–4. Correction of the mento-cervical contour by means of a full thickness free skin graft.



Case II FIG. 5. A–B, Transverse incision that permits extension of the neck and a satisfactory mentocervical curve. C, Cutaneous graft. D, Immobilization with plaster, well molded at the level of the mentocervical curve. (It is advisable to feed by means of a catheter, so as to prevent deglutition from disturbing the graft.



A B C

CASE IV

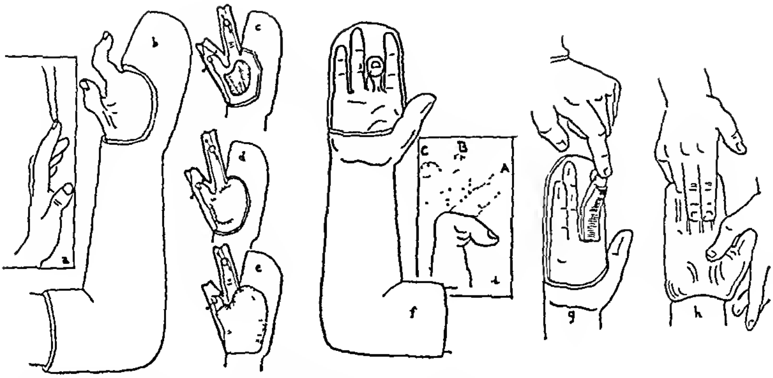
A, B, C. A Steinmann's pin that goes through the os calcis permits gradual correction of the foot, while the scar is liberated.

Case IV D. While with Steinmann's pin the correction of the foot is maintained, we make an unpadded plaster cast that covers the foot, including the pin the leg and the knee in semiflexion. Once the plaster is molded, a window is opened exposing widely the wound left by the cicatricial excision.

E. Full thickness free skin graft, in place and sutured.

F. The graft is covered with moist gauze, and a plaster splint that extends beyond the limits of the window is applied. While the plaster is stil soft, we mold carefully the external malleolar eminence and the pre- and retromalleolar depressions. This splint when hardened forms a whole with the immobilizing apparatus.

G. Aspect of the graft when the plaster is withdrawn after three weeks.



Case III FIG. 5. When the digital retraction is old and in spite of section of the bridle a complete correction is not attained, we have to maintain the finger in the best possible position, using a thread that perforates the nail (a), and in more resistant cases by means of skeletal traction that passes through the ungual phalanx, using for this the Kirschner wire (b, c, d, e). When correction is not attained without exposing it to dangerous stretching, because of the resistance of the deep tissue planes, correction is made gradually in the postoperative period with new mouldings, which are made every five days (f, g, h). In *i*, we can see the three positions A, B, C, obtained successively by these measures.

THE SURGICAL TREATMENT OF PRESSURE SORES

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Efforts directed at making the paraplegic patient ambulant have brought the problem of the treatment of pressure sores to the fore (1, 2, 3, 4). While the removal of pressure, together with good nursing, will usually result in healing, the time taken is long and, when healed, the covering is unstable.

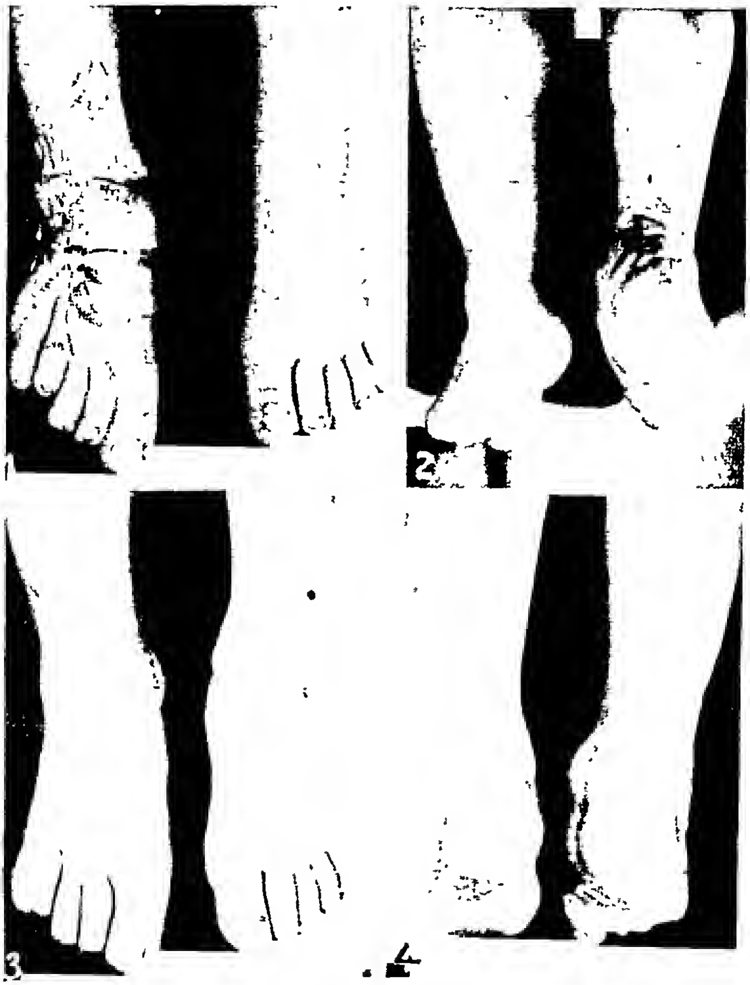
Early in 1944 the treatment of pressure sores in patients evacuated from Italy to England was demanding our attention. Healing of these sores would lessen the nursing problem, and simplify the evacuation of paraplegics to Canada. A few free grafts were tried but their use was quickly abandoned. This led to consideration of pedicle grafting. Figure I illustrates the result of the use of local rotation flaps in the treatment of two sores in an officer shot through the spine at Anzio. It soon became obvious that the best type of pedicle graft was a large local rotation flap so planned that there was a minimum of scar over the grafted area, and a minimum of scar over pressure points; an opinion also arrived at by White and Hamm (1). Pressure sores at unusual sites require special treatment. For example, a pressure sore on the sole of the foot at the base of the fifth toe was healed by excision, splitting the fifth toe down its plantar surface, removing the phalanges, and using the skin of the toe as a flap to cover the raw area.

Patients selected for operation are those in whom invasive infection is absent; whose blood urea is within normal limits; whose haemoglobin level is satisfactory; whose appetite is good and whose serum protein level is normal. If trochanteric sores are present in a patient exhibiting spasms, operation is delayed until the spasms have been eliminated. Most of these points were learned gradually, as the result of experience, and they represent our position today. These points represent the ideal state. Occasionally closure of a pressure sore must be done when conditions are not ideal. Thus the actual blood protein level may be abnormally low, and the patient steadily losing ground. In such a case successful closure of the pressure sore will abruptly stop the constant loss of protein and will in fact be a life saving measure.

The average diet given these patients is tabulated in Table I.

As these patients are given minimum definite amounts of the various dietary essentials, it is necessary to make sure that all the food is eaten. A poor appetite may be improved by the giving of insulin. The improved intake will be reflected rather quickly in the rapid healing of small indolent ulcers which now and then mark the point of separation of a suture line. Whether or not the improvement is due to the greater amount of food taken, to the improved metabolism of sugar, or partly to each, is unknown.

At first we attempted operating on these patients without anaesthetizing them. Difficulty was encountered after we began using large rotation flaps.



Case IV 1–2. Retracting scar causing an everted valgus flat foot.
3–4. Result obtained through cicatricial liberation and orthopedic correction of the foot, previous to the total free skin graft.

nitrous oxide (if electro-coagulation is used; cyclopropane if not). Attention is given to supporting the shoulders in view of the lessened vital capacity of patients when lying prone and unsupported. Since adopting general anaesthesia as a routine procedure, there has not been a single instance of collapse.

One patient has been operated upon twice to date without any anaesthetic being given. He had a section of his spinal cord high in the thoracic region removed because of intractable perineal pain which developed after his original injury. There was no untoward reaction on either occasion.

Duly anaesthetized, the patient is prepared and draped. The surface of the ulcer is cauterized with 50% silver nitrate, and the ulcer, plus all scar, completely excised. The flap is outlined with Bonney's blue to make sure that the incision will avoid bony prominences as far as possible, that the flap does not contain scar, and that the flap, when rotated, can be sutured in position without tension. It is then cut and raised. Haemostasis should be as absolute as possible, definite bleeders being ligated, oozing points coagulated. If the incision is adequately

TABLE I

Average daily diet

Protein	134 8 grams
Fat	93 8 grams
Carbohydrate	337.9 grams
Calcium	1.669 grams
Phosphorous	2 131 grams
Iron	17.15 mgm.
Vitamin A	7530 I.U.
Thiamine	1 926 mgm.
Niacin	18 22 mgm
Riboflavin	4.467 mgm.
Vitamin C	378 2 mgm.
Calories	3444

planned, being at least 5 times the distance the tip of the flap has to advance, the entire raw area can be covered without using a free graft. We have only used a free graft twice for this purpose. Braided silk 5/0 (B) and 3/0 (D) is used to sew the edges together. The heavier silk is placed at intervals, includes a good margin of skin on each side, and acts as a retention suture. Interrupted stitches of the finer silk are used for accurate coaptation of the edges. Unless the ulcer is a very small one, the patient is transfused during the operation.

Removing a portion of the underlying bone, as suggested by Greeley (5) is, in my opinion, of definite value. Not only is the path of the flap made easier, particularly in operations over the trochanters, but in addition, as Greeley points out, a better base from which to obtain a blood supply is provided.

Postoperatively moderate pressure is placed over the flap, either by crepe, or bias-cut flannelette, bandage. Posture pressure is forbidden. Penicillin, which is started as a rule a few hours prior to operation is continued for 5 days after operation—longer if indicated. The dose is either 20,000 units given intra-mus-

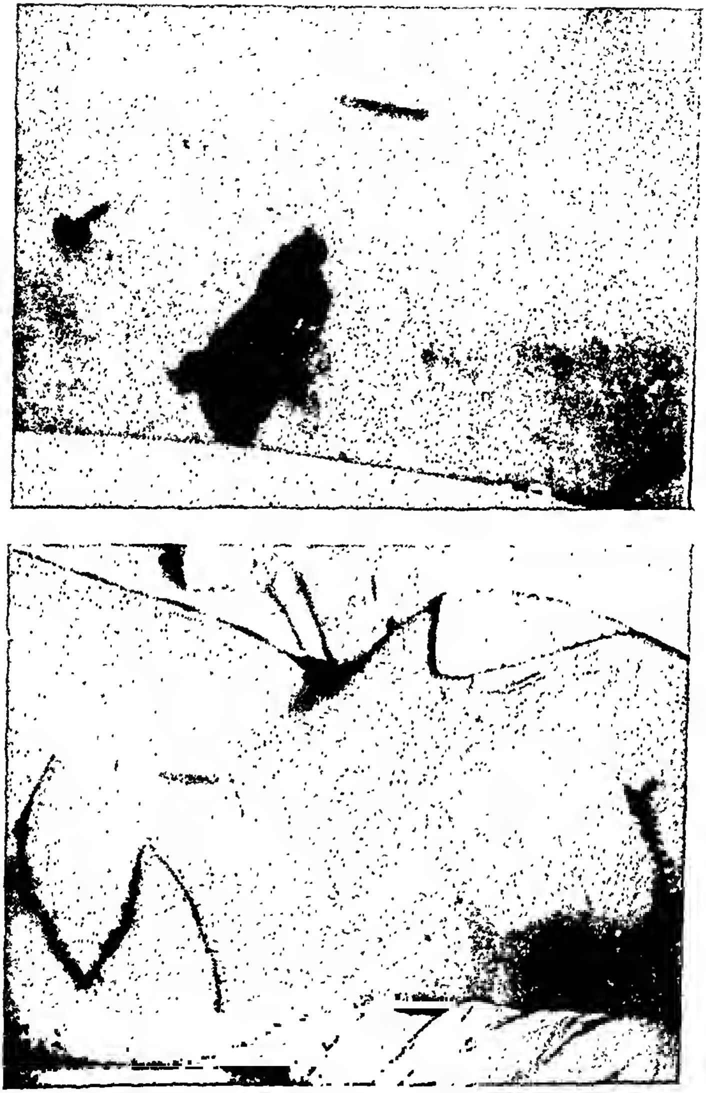


FIG. I. A, upper. Sacral and dorsal pressure ulcers in officer shot on Anzio beachhead. B, lower. The result obtained by excision of the ulcers, and closure. The sacral sore was closed by a local rotation pedicle graft; the dorsal decubitus ulcer by swinging in bilateral pedicle grafts. Operation: 17 July, '44.

The patients developed pallor, sweating, nausea, vomiting, lowered blood pressure, and a fast pulse. We have made it a routine practise to give these patients a general anaesthetic, usually pentothal induction plus endotracheal

FIG. III. A, upper. Result of closure of sacral sore by local rotation pedicle graft. B, lower. Result of closure of trochanteric sore shown in IIB at 3 weeks. A portion of the trochanter was removed with a chisel as suggested by Greeley. The tip of a secondary closure flap has been lost; at 6 weeks the entire area was well healed; at 2 months the graft over the site of the ulcer was soft and pliable.

FIG. II A, upper. Typical sacral ulcer B, lower Typical trochanteric pressure sore in same patient. A similar ulcer was present over the opposite trochanter

cularly every 3 hours, or 150,000 units given intra-muscularly continuously over each 24 hours.

FIG. III. A, upper. Result of closure of sacral sore by local rotation pedicle graft. B, lower. Result of closure of trochanteric sore shown in IIB at 3 weeks. A portion of the trochanter was removed with a chisel as suggested by Greeley. The tip of a secondary closure flap has been lost; at 6 weeks the entire area was well healed; at 2 months the graft over the site of the ulcer was soft and pliable.

If an haematoma collects beneath the flap, it may be aspirated through the flap, or between sutures. My preference is for the former method. Stitches are removed on the 18th and 21st days. If they appear to be cutting through, they are removed earlier.

Fifty operations have been done on 27 patients. A large rotation flap was used to cover the raw area left after excision of the pressure sore in 46 instances, a VY advancement in one patient, a Z-plastic shift in 2 patients, and multiple local rotation flaps in 1 patient. This last case had to have his lumbar ulcer so covered because his back was irregularly scarred; at one time the floor of the ulcer was his left kidney. The site of each operation is indicated in Table II.

Primary healing was obtained in 31 instances. There was slight separation of the suture line in 13, and marked separation in 6. Partial loss of the flap occurred in 3 patients. Thus, the immediate failures were 9 in 50 operations.

Eventually, satisfactory healing occurred in 48 patients. Two operations are complete failures. The two that have failed were both done in elderly men, one 65 and the other 67. In each case, a portion of the flap was lost. While one cannot draw any definite conclusion from this, nevertheless, I shall approach the pressure sore of an elderly paraplegic with more caution in the future.

TABLE II

Sacrum	25
Left trochanter	6
Right trochanter	8
Left buttock	3
Right buttock	4
Lumbar region	2
Iliac crest	1
Foot	1

Ulceration has recurred in three patients. In one case recurrence was due to trauma (pressure) and twice it followed the development of an abscess beneath the flap. In each the abscess occurred after the operative area had apparently been soundly healed for 4 months.

Granted the preoperative conditions outlined above, the surgical excision of pressure sores is a feasible procedure in young individuals. In my opinion, permanent closure is best obtained by the use of a large rotation flap, free of scar and tension. Free grafts to close the donor sites of such flaps are rarely needed.

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HARD DORSAL POST-TRAUMATIC EDEMA OF THE HAND

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Hard dorsal post-traumatic edema of the hand has been observed for many years; however, pathological studies have rarely been carried out. Unless one is familiar with the affliction, the true nature may not be suspected and proper treatment may not be carried out. The rarity of the condition undoubtedly accounts for the lack of clinical recognition in some instances

As the name implies, the edema usually comes on following trauma and is localized to the dorsum of the hand. There is no pitting; the swelling is hard, and it does not extend to the fingers or to the wrist. Early in the century individuals afflicted with this disability were suspected of malingering; however, since that time the organic basis has been recognized.

Kanavel describes three types of edema of the hand:

1. Recrudescing edema and pain at the site of some trivial injury.
2. Massive edema of the entire extremity with pain, usually following or concurrent with infection.
3. Hard edema after injury, but it may follow a slight infection.

We are concerned with the last mentioned group. Kanavel feels that in this group there is connective tissue proliferation and vascular obstruction secondary to long continued angio-spasm or venous inflammation.

According to Iselin (2), hard dorsal edema was first described by Secretan in 1901. Iselin states he personally has never seen a case. Tinel and Moncany (3) feel that a circulatory obstruction is present. They feel that there is vasoconstriction of the capillary and venous system and transudation occurs from the arterioles. Andre-Thomas and Kudelski (4) suggested that the edema may be due to an inflammatory process involving the lymphatics, venous system, and othef tissues.

We are reporting on two cases of hard dorsal post-traumatic edema of the hand incurred in the army and treated by excision of the mass.

CASE REPORTS

Case 1 A white male, was struck on the dorsum of the right hand by the recoil of a 75 mm gun in March 1944 A hematoma developed on the dorsum of the hand following the injury. This was removed a short time following injury The exact time that elapsed following injury until removal of the hematoma is not known Hard dorsal swelling of the hand ensued and motion became quite limited in spite of extensive activity of the hand. In addition, the patient had pain in the hand X ray therapy was given but no benefit noted Since conservative therapy did not bring about any improvement excision of the mass was decided upon

Operative findings On 19 February 1945, the mass was widely excised The tumor was found to extend widely in the form of a thickened sheet It was excised with some difficulty What appeared to be a bursal sac was present on the deep side of the tumor and both walls of this sac were completely excised

Pathological report: A frozen section was the only microscopic study made. The report was "Organized scar tissue and no evidence of tumor." No further pathological study was made of the specimen.

Complications: There was some separation of the wound post operatively. However, healing took place without further surgical intervention.

Course: The patient was carried on active physical therapy and occupational therapy and the motion rapidly returned to his hand. At the present time he has a normal functioning hand, however he does complain of some pain in the hand.

Case 2. A 26 year old negro soldier. In December of 1944 while working he sustained a wound on the dorsum of the left hand which was closed by three sutures. No disability followed this injury. In March 1945 while boxing he struck his left hand. Swelling on the

FIG. 1, left. Flexion. FIG. 2, right. Extension. Preoperative: Note swelling on dorsum of hand and limitation of flexion.

dorsum of the hand appeared almost immediately following the injury. The patient states that some blood was aspirated from the dorsum of the hand within a day or two following the injury. He was not certain of the exact date. Neither did he know the amount of blood aspirated There was no notation in his clinical record from overseas that the aspiration was done. Initially the swelling was not hard.

In August 1945, a small amount of clear serous fluid was aspirated from the dorsum of the hand. (Not done by authors). The Patient stated that firmness of the mass was noted about this time. His chief complaints were pain in the hand and limited motion of the fingers. The patient came under our care in February 1946. At that time there was limitation of motions of fingers and a firm nonpitting mass limited entirely to the dorsum of the hand (figs. 1 and 2). The fingers and wrist were not involved. Laboratory tests were essentially negative. Roentgenograms showed mild osteoporosis.

Intensive physiotherapy and occupational therapy were carried out for two months without any relief of symptoms, or without any appreciable increase in the range of motion of the fingers. Surgical excision of the mass was decided upon.

Operative findings: On 26 March 1946 the mass was explored through a curved incision on the dorsum of the hand. A very dense fibrous and cartilage-like appearing mass was encountered. The mass covered the entire dorsum of the hand. It was very intimately

associated with the skin and was situated largely dorsal to the extensor tendons, but did extend to the subaponeurotic space especially between the extensor tendons of the index and long finger.

FIG. 3 left. Mass displaced dorsal to skin flaps. FIG. 4, right. Mass displaced to demonstrate bursa deep to the extensor tendons.

FIG. 5, left. Flexion. FIG. 6, right. Extension. Four months postoperative.

A bursa measuring 3 cm. in diameter had developed within the mass just below the skin. Another bursa about 2 cm. in diameter also within the mass, was situated deep to the extensor tendons. The entire mass was removed. Sharp dissection was necessary to free

it from the skin since there was no cleavage plane. Distally where the extensor tendons have no sheath, the mass was very firmly adherent to the tendons. The mass did not

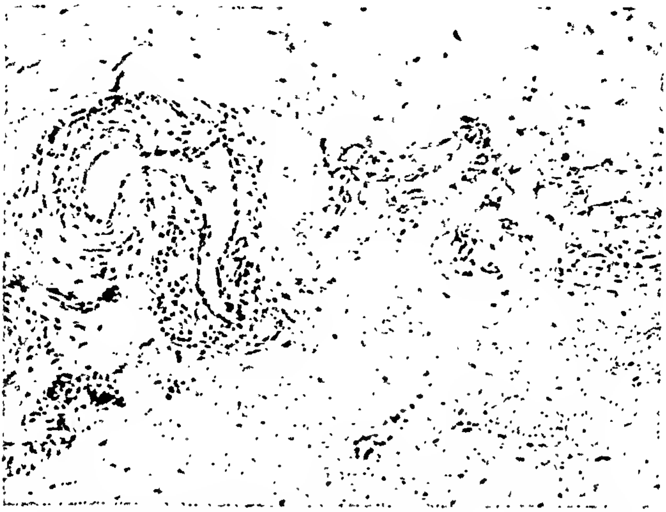

FIG. 7. ×180. Dense fibrous tissue with small island of fat. Note slight perivascular lymphocytic infiltration.

FIG. 8. ×240. Vessel showing marked thickening due to proliferation of subendothelial tissue.

extend beyond the metacarpal necks distally and proximally it did not extend beyond the base of the metacarpals (figs. 3 and 4).

Pathological report: The specimen measured 6 x 5 x 2 5 cms. Grossly the tissue consisted of pale, firm, fibrous tissue showing streaks of fat. Microscopically, the tissue consisted

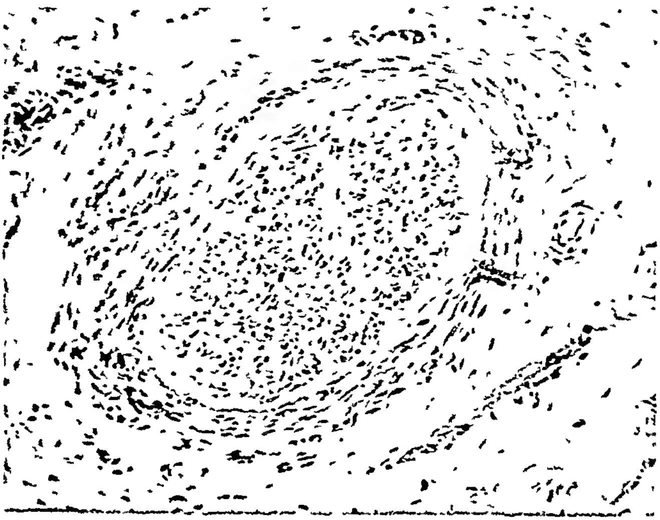

FIG. 9. ×240. Perineurial fibrosis

FIG 10. ×360 Bursa with small papillary process

of dense fibrous connective tissue arranged in bundles There were a moderate number of vessels throughout the tissue Many of the vessels showed great thickening of the walls, principally due to proliferation of subendothelial fibrous tissue, in some of the vessels there

was old thrombosis with organization and recanalization Several perivascular lymphocytic collections were present Around the nerve trunks there was considerable fibrosis Among the connective tissue bundles there were macrophages containing hemosiderin Occasional small islands of fat were present Within these areas there were a few macrophages and rare lymphocytes The bursae were lined with a layer of flat mesothelial cells (figs 7, 8, 9 and 10)

Complications A pressure dressing was applied to prevent postoperative bleeding The dressing was released by the surgeon on call on the day of surgery and a hematoma developed The hematoma was expressed through the central area of the wound which had separated The small separated central portion of the wound then healed by scar formation

Course Following the healing of the wound, physical therapy and splinting were again instituted There was slow return of function in the hand The pain gradually subsided. At the time the patient was last seen, there was still some limitation of flexion of the fingers and some discomfort in the hand (figs 5 and 6).

DISCUSSION

The cause of the hard dorsal post-traumatic edema remains somewhat obscure. The macrophages containing hemosiderin suggest that the fibrous tissue formation may be secondary to hematoma formation in some cases This is consistent with the clinical history in each of our two cases We know there is an individual predilection to keloid formation The mass removed is not unlike a keloid material. This individual variation to scar formation may explain to a point at least why this process takes place in some injured hands and not in others The microscopic sections show that the scar tissue is quite mature On the basis of this finding and also since reasonably good results follow surgical excision, we feel that complete excision of the fibrous tissue mass is the treatment of choice Skin grafting following excision of the mass may be of benefit Since the fibrous tissue is mature, spontaneous regression is not likely

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EXPERIMENTAL AND CLINICAL STUDIES OF REDUCED TEMPERATURES IN INJURY AND REPAIR IN MAN[1]

I. Structure and Potentialities of Human Skin in Temperature Control and in Defence Against Thermal Trauma[2]

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INTRODUCTION

A. The purpose of investigation and review of literature

The understanding of the reaction of human tissues to reduced temperatures of various degrees of severity is becoming more urgent in recent years. Modern warfare subjects large numbers of individuals to the influence of either prolonged moderate cold, as in immersion foot suffered by shipwrecked mariners, trench foot prevailing among the infantry personnel, or to the action of severe cold as in high altitude flying. The casualties due to cold have been particularly large in the American, German and Russian armies of World War II. At the present time extensive explorations are being carried on in the field of stratosphere operations with inevitable exposure to sub-zero temperatures. Studies of the limit of endurance of army personnel under the influence of low temperatures are in progress in Northern Territories. Elective refrigeration has had many advocates for the purpose of anaesthesia and as a means of treatment of gangrene and other vascular disorders. Moreover, being a "thermal injury", understanding of the pathogenesis of injury by cold and the study of the reaction of human tissue to various degrees of reduced temperature should also throw some light upon the problem of burns and other allied types of trauma.

The pathogenesis of injury by cold has not been conclusively settled. Most of the reported observations have been based on the study of amputated limbs and only a few of the studies published have been based on experimental investigation where the circumstances of injury were known or controlled. Nevertheless, a considerable amount of literature on the effect of cold has accumulated and a number of excellent up-to-date reviews have appeared in recent years, (Smith et al. (1, 2), Lewis and Love (3), Lewis (4, 5), Brownrigg (6), Strumia and Hodge (7) and others (11, 17, 20, 22). In order to avoid needless repetition an attempt was made to crystallize the factors extracted from some of the recent reports into working theories of pathogenesis of cold and to tabulate them chronologically (Table I). This list does not pretend to be complete and to avoid repetition only certain authors were included—they are representative of this or that point of view, but were not necessarily the first to express it.

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TABLE I

Pathogenesis of injury by reduced temperatures

AUTHOR AND YEAR	WORKING THEORIES
Larrey (8) 1812	(1) Cold causes direct death of the part in certain cases. (2) Secondary effects are due to vascular insufficiency which leads to congestion, superficial blistering and local inflammation. (3) Suddenly applied heat is the determining cause of gangrene.
Smith et al. (1, 2) 1915	(1) The most important effect of cold is on the vessels (endothelial swelling, dilatation of lumen). (2) Changes in tissue are due primarily to transudation that follows. (3) Oedema separates fibrous bundles causing swelling and distintegration. (No evidence of thrombi in vessels.)
Lewis (3, 4) 1926, 1941	(1) Reaction is due to damage of tissue by cold. (2) Ice formation in tissue adds to damage of tissue. (3) Necrosis is due to injury to blood vessels and thrombosis. Oedema itself adds more damage. (4) Susceptibility to vasoconstriction and defective circulation predisposes to damage by cold.
Webster et al. (9) 1942	(1) Cold causes direct damage of tissue, vessel wall, peripheral nerves and end-organs. (2) Tissue damage results in intense vaso-dilation so that a vicious circle between oedema and oxygen debt follows. (3) Extending thrombosis in vessels in region adjacent to traumatized area.
Brownrigg (6) 1945	(1) Essential feature is inflammatory reaction as result of cold. (2) Damage to blood vessels results in inflammatory endarteritic change leading to narrowing of lumen. (3) Lesion identical whether the cold is moderate and exposure is long or if cold is severe and exposure is short.
Friedman (10) 1946	(1) The process is an "Agglutinative Thrombosis" as a result of cold. Most changes are secondary to vascular occlusion. (2) Direct cold damage to fat, lipo-proteins and muscle. Ice crystal formation is not important in causation of injury. (3) Differences in extent of injury are due to rapidity, severity and duration of exposure.
Kreyberg (12) 1946	(1) Cold causes acute aseptic inflammation as a result of lowered temperature and deprivation of oxygen. (2) Vascular reaction is local and is limited to minute vessels where increased permeability leads to "STASIS." (3) Actual freezing of tissue increases degree of damage.

A cavalcade of theories have been proposed for the past 130 years on the pathogenesis of injury by cold. Beginning with Larrey's concept based on the methodical observations during the Napoleonic campaigns (8) almost all the-

ories that followed implicated the interaction of several factors, namely, direct action of cold on tissue, damage of vascular apparatus and secondary changes associated with either the former or the latter. However, different investigators put special stress on one or the other of the factors enumerated, considering them to be the "primary" ones in reaction to cold.

The reason for this discrepancy, which is not peculiar to investigators of this field alone, may be due to the fact that most observations on clinical cases are made on the "end result" where it is difficult to determine which of the factors observed is the cause and which the consequence. Moreover, even in carefully controlled experimental studies it was not possible to separate the different elements involved for the observations of their individual response to moderate or severe cold. It is precisely with the last stated concept in mind that the present study was undertaken.

The purpose of this investigation was to study the direct effect of a sequence of cold temperatures on the human tissues (skin grafts) free of vascular and nerve elements and subsequent correlation of these observations (a) with the effect of cold on normal intact skin, (b) with the effect of cold on healing and freshly-healed surfaces, all under controlled conditions, and (c) with the findings in actual clinical cases. It was hoped that better understanding of the pathogenesis of injury by cold, the effect of cold on wound healing and a more effective approach to treatment would result.

B. The balance of temperatures

Some general and relevant concepts must be considered before the discussion of the study of the mechanism of injury of human tissue by adverse temperatures, either cold or heat, can be carried on with any degree of accuracy. The terms "hot" or "cold" are relative ones and are meaningless without their standard of reference. The temperature prevailing at any one point is the result of interaction between heat production and heat loss. Some animals have no constant body temperature of their own but are influenced by the temperature of their environment: this shows an extreme degree of adaptation of their tissues. However, human tissues thrive best at the temperature of 98° to 99°F. (37°C.) and this is the level at which the balance of heat production and heat loss is maintained: indeed, so successful is the human body in maintaining this balance at a constant level that it is used as one of the criteria of health. The source of heat in the human body is the energy resulting from the metabolism of all body tissues, and the basal heat loss is due to dissipation of heat by convection, radiation, and evaporation into the environment which is usually somewhat "colder" than the body temperature. We shall use the temperature of the human body as our standard of reference throughout this paper.

Sudden alterations of the environmental temperature may render the heat production or the heat loss insufficient, thus upsetting the balance of the two factors. But the body possesses controlling mechanisms which can be brought into play and either alter heat production or adjust heat loss. Moreover, the existence of a special organ makes regulation of body temperature and adapta-

tion of the human body to variations of environment more effective—this organ is the skin.

SKIN—FIRST LINE OF DEFENCE

A. Structure and potentialities

The skin may be considered as one of the largest organs in the body as it comprises about $\frac{1}{6}$ of the total body weight (13). It mediates the impact of the

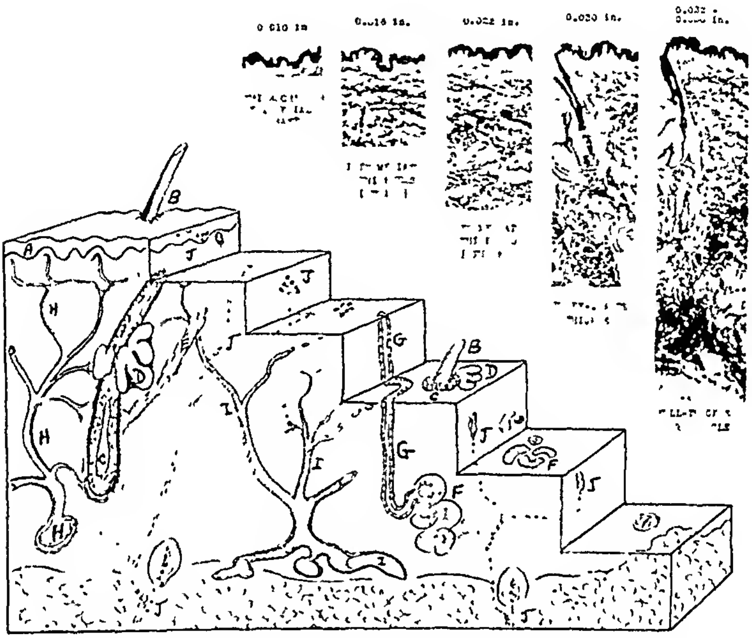

FIG. 1. DIAGRAMMATIC APPEARANCE OF NORMAL SKIN RECONSTRUCTED FROM NUMEROUS SERIAL HISTOLOGICAL SECTIONS SIMILAR TO FIG 2 WITH THE AID OF CAMERA LUCIDA

The collagen and elastic bulk of the dermis is omitted A—epidermis B—hair. C—hair follicle D—sebaceous gland. E—smooth muscle F—sweat glands. G—sweat duct. H—arterial tree. I—venous tree J—nervous system and nerve endings. The distribution of the nerve fibres and position of nerve endings is modified after G. Weddell (19). The microphotographs above the diagram represent portions of skin corresponding to the skin grafts of various thicknesses

external environment and protects the underlying tissue This organ has a complex structure made up of surface epidermis, underlying dermis and subcutaneous layer, cutaneous appendages, blood vessels, lymphatic channels and nerves (fig. 1). It is the epithelial covering of the skin that permits it to withstand a relatively greater insult than that endurable by the underlying elements of the skin. The epidermis is made up of several layers of cells whose vitality is directly proportional to the distance of the various cell layers from the source

of nutrition and oxygen supply. The innermost or deepest layer of the epidermis is nearest to the capillary loop and is composed of actively dividing groups of cells. It is this layer of epidermis which is responsible for the relatively unique property of all epithelia—almost perfect regeneration after injury. The activity of the cells is diminished as one progresses upwards: eventually there is loss of nuclei and of water content. At the very surface is the horny layer of the skin—a desiccated remnant of the epithelial cells which is extremely static, can endure mechanical and thermal trauma, and is compared with shingles on a roof which have occasional cracks (13). The bulk of the skin is made up of the dermis (fig. 2) which is composed of collagenous, reticular and elastic fibres

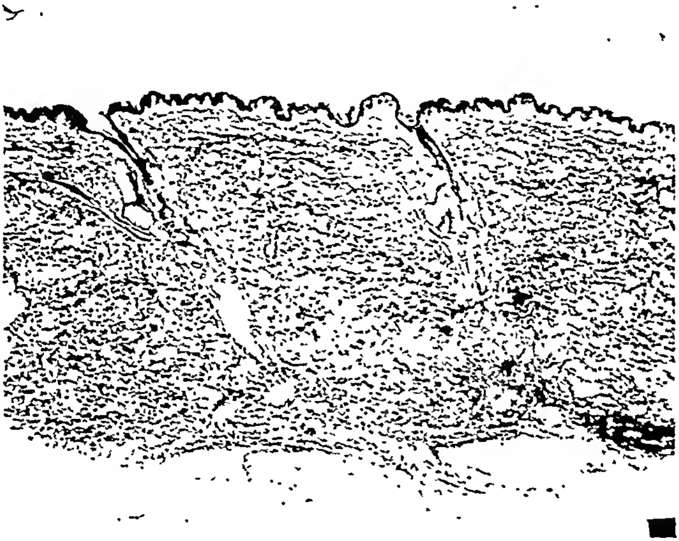

FIG. 2. NORMAL HUMAN SKIN

This section was taken from the lumbar region of the back and is somewhat thicker than the skin in other sites. The epidermis is seen to invaginate into the hair follicles. Sebaceous and sweat glands are lighter staining. The bulk of the skin is made up of dermis which covers most of the section, the subcutaneous fat is seen at lower margin. Haematoxylin-eosin. Magnification × 25.

whose main function is support, insulation and maintenance of normal tension of the skin (fig. 3). The dermal components do not regenerate but are repaired by fibrous tissue (fig. 6).

The cutaneous appendages are invaginations of skin epithelium containing hairs, sebaceous glands, sweat glands and ducts. These structures have been incorporated into the diagrammatic representation of skin (fig. 1) reconstructed from serial histological sections of normal skin by means of camera lucida drawing so that normal relationship is maintained although the collagen and elastic bulk of the dermis was omitted. The hair follicles and the glands may be regarded as invaginations of the epidermis. Each hair has a sheet of smooth

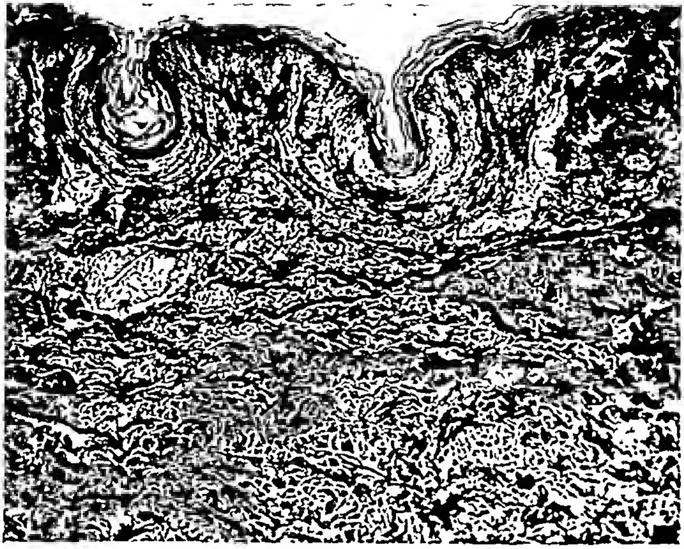

FIG. 3. NORMAL HUMAN SKIN STAINED TO SHOW THE COLLAGEN FIBRES AND ELASTIC FIBRES

The elastic fibres are very fine in the subepidermal layer and get thicker in the deeper layer of the dermis. Verhoeff's elastic tissue stain. Magnification × 80.

FIG. 4. TRANSVERSE SECTION THROUGH NORMAL SCALP AT A DEPTH OF 0.018–0.020 INCHES FROM THE SURFACE

Note the hair follicles with the clusters of sebaceous glands and the relation of the smooth muscles to these structures. Haematoxylin-eosin. Magnification × 50.

FIG. 5. A PORTION OF CAPILLARY LOOP IN THE PAPILLA OF NORMAL SKIN

The upper end of loop extends almost to the inferior surface of epithelium. Note the thin walls and the caravan of red blood cells which can be seen along the entire length of the capillary. Haematoxylin-eosin. Magnification × 260.

FIG. 6. DERMATOME SKIN GRAFT (0.016 INCHES) SHOWN AT THE JUNCTION WITH THE HOST SKIN (RIGHT MARGIN) AT ONE MONTH AFTER GRAFTING

Note the character of the intervening fibrous tissue lacking collagen and elastic fibres. Verhoeff's elastic tissue stain. Magnification × 50.

muscle which extends from the lower third of the hair follicle to the upper surface of the dermis (figs. 1, 2, 4). Its function is to raise the hair from the surface of the skin, thus increasing the layer of static air which acts as an insulator against the cool temperature of the environment, and to extrude some sebum from the sebaceous glands. This phenomenon is somewhat of an atavism in man, although the mechanism is still active and is responsible for the production of "goose-pimples". The importance of hair follicles in regeneration cannot be minimized. It is the proliferation of epithelium from the hair follicles that permits rapid healing of donor areas, skin abrasions and moderate burns (fig. 4). The other sources of epithelium are proliferation from the edges of the wound, from sweat ducts and from sebaceous glands in areas where hair follicles are absent. The proliferation from the wound edge is the manner in which re-epithelization occurs in small abrasions, closed surgical and traumatic incisions, and granulating areas devoid of all other sources of epithelium. The sweat glands act as miniature excretory organs and are important in heat dissipation. The sebaceous secretion is believed to be a product of true glandular activity (13). It is composed of several types of fatty acids and neutral fat and is thought to serve as a protective coating for the skin.

The vascular trees have been similarly reconstructed from serial sections (fig. 1); although the calibre of the smaller vessels is not entirely accurate, the actual scheme of distribution has been retained. The exchange of gases and of nutritive materials takes place only across the specialized membrane of the capillary endothelium. No diffusion takes place through the relatively thick walled arterioles, consequently capillary loops are carried to the interspace of dermis and epidermis (fig. 5), to hair follicles, sebaceous and sweat glands, nerve trunks and sense organs, and other vital structures (fig. 1). The venous system has a similar distribution. The vascular tree is a dynamic system of vessels constantly changing its volume. It is under continuous influence of the vasomotor (sympathetic) discharges and the variations of pressure transmitted from the heart. Moreover, various substances which can gain access to the vessels through the circulating blood or body fluids have a specific effect upon the state of the smaller vessels: adrenalin causes contraction, histamine causes dilatation. Noxious metabolic products and lack of oxygen can influence the state of minute vessels. There is also a ready response to the direct influence of the external temperature.

The nerve network makes possible the perception of sensory stimuli, the execution of the reflexes and the maintenance of the motor discharge—in short, the complex task of integration.

B. The role of skin in temperature control

It was stated earlier that the human body strives to maintain a constant temperature by bringing into play various controlling mechanisms. The increase of heat production is brought about by increase in metabolic rate, unconscious tension of muscles and shivering. There may also be an increase in conservation of heat. The increase of heat loss is effected by increasing the

surface of skin circulation and thus permitting more extensive loss of heat by convection and radiation; by increase of sweating and panting which increases the loss of heat through the insensible and sensible evaporation. Heat loss, on the other hand, can be checked by decreasing the rate of sweating and restricting the amount of blood flow through the superficial layers of the skin.

Of the total elimination of heat from the body 70% is accomplished by radiation, conduction and convection from the skin, the remainder by vaporization through lungs and skin (23). It is in the regulation of heat loss that the skin plays a very significant part. In sudden increase of heat production as Hardy and his coworkers have shown (14), the regulating mechanism is too slow. Such is the case with strenuous exercise where the rise of metabolic rate is extremely rapid. The body temperature rises from 99.5° to about 102°F. (rectal); an accompanying increase in heat loss by vaporization is noted (up to 3 times the normal rate). The skin temperature fell about 5.4°F. (from 91.4° to 86°F.).

The importance of the skin in the control of heat through the vasodilation and secretion of sweat is demonstrated in patients having extremely high fever accompanied by "chills". The skin is pale, cold and dry indicating a marked vasoconstriction. The cause of this fall of skin temperature is not known but it gives the patient the sensation of cold and stimulates the body's mechanisms of heat production (in spite of already existing high fever). Shivering is produced by alternate fine contraction of skeletal muscles and "goose flesh" may also appear. When the body temperature reaches a certain height the vasospasm of the skin vessels is released and heat elimination by the skin is again re-established.

If the changes of temperature are slow, gradual re-adjustment takes place. Such alterations occur in seasonal changes: with the approach of cold weather there is a re-distribution of body water, decrease of blood volume and an increase of metabolic rate. There is also a generalized constriction of skin arterioles and venules. On the other hand, with warmer temperatures there is a reversal of the changes, and dilatation of cutaneous vessels takes place (23). It is in this manner that people living in localities with predominating extremes of either cold or heat are "tuned up" for conservation or dissipation of heat. This adaptation is not always adequate, and it is the "insufficient" preparation of the body to the insult of cold that is considered to be a contributing factor in the production of frostbite. More than one-third of all frostbites in the far north occur in the first two, relatively warm months of winter (24).

C. Skin reaction to local temperature changes

While body temperature, as measured by mouth or by rectum, is fairly constant, the surface temperature of the skin is not the same throughout the body. The average value for skin temperature was found by Eddy and Taylor (25) to be 90.5°F. (32.5°C.). The temperature of the feet is considerably lower. This shows a certain degree of local adaptation of tissues. While the body as a whole cannot endure prolonged elevation of temperature above 107°F. or prolonged decrease below 68°F. (23) the skin can withstand local application of a

muscle which extends from the lower third of the hair follicle to the upper surface of the dermis (figs. 1, 2, 4). Its function is to raise the hair from the surface of the skin, thus increasing the layer of static air which acts as an insulator against the cool temperature of the environment, and to extrude some sebum from the sebaceous glands. This phenomenon is somewhat of an atavism in man, although the mechanism is still active and is responsible for the production of "goose-pimples". The importance of hair follicles in regeneration cannot be minimized. It is the proliferation of epithelium from the hair follicles that permits rapid healing of donor areas, skin abrasions and moderate burns (fig. 4). The other sources of epithelium are proliferation from the edges of the wound, from sweat ducts and from sebaceous glands in areas where hair follicles are absent. The proliferation from the wound edge is the manner in which re-epithelization occurs in small abrasions, closed surgical and traumatic incisions, and granulating areas devoid of all other sources of epithelium. The sweat glands act as miniature excretory organs and are important in heat dissipation. The sebaceous secretion is believed to be a product of true glandular activity (13). It is composed of several types of fatty acids and neutral fat and is thought to serve as a protective coating for the skin.

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unaffected cells by coming in contact with them when the normal temperature is restored. Peters (28) has demonstrated that in the skin exposed to moderately "hot" temperature (140°–150°F.) cell damage occurs and enzymes are released; the activity of the enzyme is only partly curtailed by the above temperature.

These are only some of the factors that must be considered when the living tissue is exposed to the influence of reduced temperatures. When a portion of the human body is locally chilled or frozen there results a gradation of temperatures which may range from a very low level at the surface of the skin (if carbon dioxide snow was used, for example) through the different levels of temperatures until normal body temperature is reached at some distance from the skin surface; the metabolic alteration will be proportional to the temperature at a particular level and will prevail only as long as the temperatures are maintained, but the destruction of the integrity of cells and sequelae of the physicochemical alterations of living matter may become apparent only after a lapse of time.

These are some of the "direct" effects of cold that influence all tissues, and which underly all reactions that follow exposure of living human tissues to the action of reduced temperatures of various degrees. However, the sequelae that follow these "direct" effects depend upon the type of tissue involved and may be superimposed upon them to such an extent that it is difficult to interpret what had been the primary cause, and what the effect. The intrinsic damage due to cold for example, might be the same to both the epithelial cell of the epidermis and to the endothelial cell of the underlying capillary and would result in considerable impairment of their function and, perhaps, even ultimate death. But, the leakage of plasma that follows even partial damage of endothelial cells may so impair the oxygen exchange, that many epithelial cells which had been only partially damaged, are "pushed" over into irreversible damage. Unless the sequences of events have been carefully followed, it becomes extremely difficult to allocate the contribution of each of the many factors involved to the ultimate result.

B. Phases of investigation

In view of the previously considered factors it becomes imperative to carry out investigations and observations under conditions where the interplay of the various factors is known or can be determined at all times, and where compatible controls are constantly available. Such a set-up has not been invariably obtained, but we attempted to get as near as possible to it.

One of the first phases of our investigation entailed the study of the behaviour of wound healing and tissue regeneration under the influence of "moderate" cold. We chose "dermatome donor sites" (areas from which uniform thickness of skin has been removed with the Padgett-Hood dermatome) on the thigh as the standard area. Fresh dermatome donor sites have several features which make them particularly suitable for the study of the influence of a specific factor on wound healing:

(a) Uniform thickness of split-skin can be removed from two or more com-

much wider range of temperatures. Short contact with temperatures of 130°F. (55°C.) on the warm side and 32°F. (0°C.) on the cold side do not produce immediate death of skin—although prolonged exposure may precipitate certain changes. Lewis made an extensive study of the local reaction of human skin to cold (3, 4, 5). He observed that vasodilation occurs in the skin of the fingers after immersion in cold water of 65°–60°F. (18°–15°C.) for 5 to 10 minutes. The vasodilatory reaction reached a peak at about 15 to 20 minutes after removal from cold water, and then subsided slowly (5). The mechanism of this phenomenon was thought by Lewis to be due to release of H-substance which awakened the axon reflex. Application of cold temperature to one limb results in a "reflex" vasoconstriction of the contralateral and other limbs. Warming of one limb produced vasodilatation in the other limbs (23).

A few phenomena discussed above reflect the behaviour of skin in the range of physiological adaptation. The implication of these phenomena will be further considered in subsequent reports of experimental and clinical investigations (16).

GENERAL NATURE OF INVESTIGATIONS

A. *Investigation of factors implicated in pathogenesis of injury by cold*

Exposure of living tissue to different temperatures produces alterations in the rate of metabolic processes commensurate with the effect on the rate of chemical reaction and enzyme action. The effect of cold on the rate of chemical reaction and on behaviour of organic substances in vitro has been thoroughly studied and is well known. Similar effects take place in vivo although they are not as easily demonstrated and sometimes have to be inferred. But, although the different processes are all affected by cold, the degree of the influence is not identical for a particular temperature. For instance, the rate of dissociation of oxygen between 55°–32°F. is relatively less reduced than the rate of the oxygen utilization by the tissue. The result is that there may be an excess of oxyhaemoglobin in that area. At temperatures between 77° to 60°F. the oxygen tension is low, but the tissue requirement is not proportionally decreased—consequently, there results an inhibition of anabolism, whereas katabolism is not materially affected. Thus, although the exposure of tissue to "moderate" cold may not produce visible alterations of its structure (21), there may be considerable alterations in its function.

The structural configuration of organic matter is little affected by moderate cold, but freezing (ice-formation) introduces physico-chemical alterations of colloidal systems entailing dehydration, splitting of radicals and denaturation of proteins (26). There are other changes inherent in freezing which may destroy the enzyme-systems involved in vital processes (e.g. the enzyme-system of oxidation which is destroyed at −100°F. (27), but we have little information about the relative survivals of enzymes as compared with the physical alterations of the cell protoplasm. It is conceivable that cold may damage the cell sufficiently to cause a disintegration of the cell membrane, yet not completely destroy the enzymes thus released. Such enzymes could act upon the distant

unaffected cells by coming in contact with them when the normal temperature is restored. Peters (28) has demonstrated that in the skin exposed to moderately "hot" temperature (140°–150°F.) cell damage occurs and enzymes are released; the activity of the enzyme is only partly curtailed by the above temperature.

These are only some of the factors that must be considered when the living tissue is exposed to the influence of reduced temperatures. When a portion of the human body is locally chilled or frozen there results a gradation of temperatures which may range from a very low level at the surface of the skin (if carbon dioxide snow was used, for example) through the different levels of temperatures until normal body temperature is reached at some distance from the skin surface; the metabolic alteration will be proportional to the temperature at a particular level and will prevail only as long as the temperatures are maintained, but the destruction of the integrity of cells and sequelae of the physicochemical alterations of living matter may become apparent only after a lapse of time.

These are some of the "direct" effects of cold that influence all tissues, and which underly all reactions that follow exposure of living human tissues to the action of reduced temperatures of various degrees. However, the sequelae that follow these "direct" effects depend upon the type of tissue involved and may be superimposed upon them to such an extent that it is difficult to interpret what had been the primary cause, and what the effect. The intrinsic damage due to cold for example, might be the same to both the epithelial cell of the epidermis and to the endothelial cell of the underlying capillary and would result in considerable impairment of their function and, perhaps, even ultimate death. But, the leakage of plasma that follows even partial damage of endothelial cells may so impair the oxygen exchange, that many epithelial cells which had been only partially damaged, are "pushed" over into irreversible damage. Unless the sequences of events have been carefully followed, it becomes extremely difficult to allocate the contribution of each of the many factors involved to the ultimate result.

B. Phases of investigation

In view of the previously considered factors it becomes imperative to carry out investigations and observations under conditions where the interplay of the various factors is known or can be determined at all times, and where compatible controls are constantly available. Such a set-up has not been invariably obtained, but we attempted to get as near as possible to it.

One of the first phases of our investigation entailed the study of the behaviour of wound healing and tissue regeneration under the influence of "moderate" cold. We chose "dermatome donor sites" (areas from which uniform thickness of skin has been removed with the Padgett-Hood dermatome) on the thigh as the standard area. Fresh dermatome donor sites have several features which make them particularly suitable for the study of the influence of a specific factor on wound healing:

(a) Uniform thickness of split-skin can be removed from two or more com-

parable sites, thus providing standard areas where spontaneous healing with fibrous tissue formation and epithelization can occur (fig. 8).

(b) The behaviour and rate of epithelial regeneration and fibrous tissue formation has been extensively studied; a standard type of dressing giving optimal spontaneous healing is now routinely used on all of our cases of skin grafting. Thus a condition where alterations of temperature of the environment is the only variable factor is provided.

(c) The location of the donor site on the limb permits subjection to a constant temperature without undue discomfort to the patient.

The range of the temperatures studied and the details of the methods of cooling will be incorporated in the subsequent paper (16).

In order to separate the different elements involved in the influence of moderate or severe cold on the tissue so that the study of the direct effect of cold could be carried on, we selected the free split-thickness dermatome skin graft. Free skin grafts are peculiarly suitable for such study: (a) They are uniform in thickness. (b) They are deprived of nerve and blood supply. (c) They can be subjected to various measured temperatures for definite periods of time. (d) They can be replaced back on a suitable bed in the host where their behaviour can be studied by biopsies and other methods (fig. 6).

The range of temperature studied extended from 39° to −108°F. (4° to −78° C.) and the time of exposure varied from a few hours to several months. The details of this method will be described in the subsequent reports (16).

The study of the vascular response to reduced temperatures was carried out by means of subjecting normal skin of young adults to cool air which was circulating in a special chamber; the apparatus will be described in the next paper (16). The character of the vascular response was followed by observing the clinical appearance, the skin temperatures (measured with the thermocouples) and by taking frequent biopsies which permitted correlation of the clinical observations with histological findings. Similar studies were carried out on tube pedicles (fig. 7) whose vascular supply was intact, but in which the nerve supply had been interrupted by transplantation of the pedicle, and also on recently healed and "old" donor sites.

The study of the vascular elements in their reactions to reduced temperatures inevitably involves the consideration of the nervous mechanism both in its relation to the direct damage by cold and to the sequelae that follow the initial vascular impairment (15, 18). Observations were carried out on the vascular response of normal intact skin to the influence of a whole range of "cold" temperatures. These were compared with the reaction of (a) recently healed donor sites, where the restitution of the nervous system has not yet taken place, (b) with pedicle flaps deprived of their nervous connection with the body, and (c) with the recently healed and "old" skin grafts. Thus, we were able to interpolate the role of nervous elements in the summation of reactions to cold and freezing (16).

Any tissue subjected to the dual insult of "direct" effect of cold and of the sequelae that are secondary to the impairment of the function of the vascular

FIG 7 TRANSVERSE SECTION OF A TUBE PEDICLE RAISED FROM THE SKIN ON THE LATERAL ASPECT OF THE NECK IN AN ADULT MALE

The section was removed after a third "transplant" of the pedicle Note the regular arrangement of hair follicles, the central fibrosis within the subcutaneous fat and the distribution of blood vessels Masson's trichrome stain Magnification × 5

FIG 8 NORMAL SKIN (RIGHT HALF) AT THE JUNCTION WITH DERMATOME DONOR AREA (ANTERIOR SURFACE OF THE THIGH) FROM WHICH 0 016 INCHES OF SKIN HAS BEEN REMOVED

Spontaneous regeneration of epithelium on the donor site takes place from the marginal proliferation and from sectioned ends of hair follicles and sweat ducts Haematoxylin eosin Magnification × 40

parable sites, thus providing standard areas where spontaneous healing with fibrous tissue formation and epithelization can occur (fig. 8).

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FIG. 7. TRANSVERSE SECTION OF A TUBE PEDICLE RAISED FROM THE SKIN ON THE LATERAL ASPECT OF THE NECK IN AN ADULT MALE

The section was removed after a third "transplant" of the pedicle. Note the regular arrangement of hair follicles, the central fibrosis within the subcutaneous fat and the distribution of blood vessels. Masson's trichrome stain. Magnification × 5

FIG. 8. NORMAL SKIN (RIGHT HALF) AT THE JUNCTION WITH DERMATOME DONOR AREA (ANTERIOR SURFACE OF THE THIGH) FROM WHICH 0 016 INCHES OF SKIN HAS BEEN REMOVED

Spontaneous regeneration of epithelium on the donor site takes place from the marginal proliferation and from sectioned ends of hair follicles and sweat ducts Haematoxylin-eosin. Magnification × 40.

apparatus are prone to show some changes in the response to bacterial invasion whether by known pathogens or by "innocent" local inhabitants. The study of the resistance of chilled and refrigerated skin to bacterial attack was carried out with the assistance of the Department of Bacteriology and will be described in detail in our future reports.

C. *Correlation of the experimental observation with clinical problems*

The experimental investigations which have been carried out do not pretend to cover all aspects of the pathogenesis of injury by reduced temperatures. The primary stress was placed on the determination of the direct effect of cold on the various components of the skin and on the vascular and nerve elements in healthy young adults under conditions where the two main variables have been the temperature and the duration of exposure. In actual clinical cases other factors must be considered which may play a contributory and even a determining part in the final outcome of the injury by cold. These include the state of peripheral circulation in the individual, the presence of specific vascular disease, the individual susceptibility to cold, the condition of the skin of the exposed part, the local factors which prevail at the time of exposure (e.g. wetness, constriction, immobilization, etc.) and many others. Some of these factors have been appraised by studying the effect of reduced temperatures on healed scars, donor sites, skin grafts and tube pedicles, under conditions where the temperature and the duration of the exposure were known. The clinical appearance during and after exposure was carefully recorded; the histopathological changes were followed through the biopsies; the vascular response determined by the skin temperature readings and the histological examinations.

Thus, it is possible to correlate the information obtained from the experimental studies with the clinical problems, in which the condition of exposure to cold is unknown and where the extent of tissue damage and prognosis are not immediately determinable. Some light is also thrown on the pathogenesis of injury by cold. These are the salient points of this investigative project. The detailed account will be presented in the series of papers that are to follow. The method of investigation used in this project lends itself favourably to the experimental study of the pathogenesis and treatment of burns, and experiments in this field are already in progress (29).

SUMMARY

1. The reason for the importance of understanding the effects of reduced temperatures on human tissues have been enumerated.

2. The approach to the investigations are discussed in the light of the factors considered by various investigators to be involved in the production of injury by moderate and severe cold.

3. The importance of skin in the regulation of body temperature in the range of physiological adaption, and as the first line of defence against thermal trauma is pointed out.

4. The structure of the skin is discussed: the relationship of the component parts is illustrated diagrammatically and with the aid of colored photomicrographs.

5. A new method of approach for the study of the individual factors believed to be involved in the injury by cold in man has been devised. Its application to other fields of investigation is emphasized.

6. The various phases of investigation have been outlined and these will subsequently appear in the following reports: (a) Effect of moderate cold and refrigeration on wound healing and regeneration of human skin. (b) Direct effect of cooling and freezing on various elements of the human skin. (c) Effect of cooling and freezing on vascular and nervous elements of human skin. (d) Resistance of refrigerated skin to bacterial contamination and to infection. (e) Pathogenesis of injury by cold based on correlation of the experimental findings with clinical data.

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USE OF NECK TUBED PEDICLES IN RECONSTRUCTION OF DEFECTS OF THE FACE

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INTRODUCTION

In the definitive surgery of facial defects the neck tube has served a major role. The purpose of this paper is to discuss (1) the advantages of neck pedicle skin in certain types of facial reconstruction, (2) important points in the surgical technic, and (3) some typical cases in which neck tubes were used for reconstruction. Only those problems pertaining to loss of skin and deeper structures which are not adaptable to the use of full thickness grafts, local flap shifts, fractional excision, or Z-plasty with its modifications will be discussed.

When possible, one should attempt to utilize the tissue at hand in correcting facial defects. Local flap shifts and modifications of the Z-plasty are the methods of choice. Where local flap shifts are not feasible and skin and subcutaneous tissue is needed for the repair of facial defects, one is forced to bring new tissue from some distant point.

Neck tubed pedicle skin is indicated for almost any defect of the face, forehead or oral cavity requiring skin and subcutaneous tissue from a distant point, providing the defect is not too large for the amount of neck tissue available.

ADVANTAGES OF NECK PEDICLE SKIN

Tubed pedicle skin from the neck for facial reconstruction is superior to other types of pedicle skin for the following reasons:

1. Better color and texture match.
2. Production of minimal defect in the donor area (Plate II, figs. B, C, D).
3. Ideal thickness.
4. Proximity of tissue to be moved.
5. Greater vascularity of the neck skin.

Certain individuals with dark complexion, particularly those of Latin descent, have a marked tendency to pigment any type of skin transferred from one point to another, whether it be pedicle or free transfer. This disadvantage is inherent in all types of grafting in these individuals and is not peculiar to neck pedicle skin alone.

In the male one is faced with transferring both hair-bearing and non-hair-bearing skin, depending upon the location of the defect. Both types of skin are usually available on the neck by proper planning of the location of the pedicle, either inside or outside the hair line.

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It is an accepted fact among plastic surgeons that the skin of the forehead produces the best color match and consistency in rhinoplasty. At the same time, because of the prominent location of the forehead, a most objcctionable defect is produced which cannot be totally corrected by thick split or full thickness grafts. The rationale of producing another glaring defect to correct the original does not follow.

The thickness of the subcutaneous tissue of neck pedicles is such that secondary defatting procedures to obtain proper contour become less necessary.

The proximity of the neck skin to the face eliminates repeated waltzing procedures, as well as bizarre and uncomfortable positions of the patient in plaster cast fixation, required in the transfer of pedicle skin from the arm to the facc.

The vascularity of the neck skin, like that of the face is more extensive than that of other regions. This assures easier handling and greater viability of any pedicle skin transferred from the neck.

IMPORTANT POINTS IN THE SURGICAL TECHNIC

When considering the formation of a neck tubed pedicle, the following points must be taken into account:

1. The amount of tissue needed.
2. The distance from the neck to the defect.

In determining the amount of tissue that must be transferred, excision of tissue around the defect and shrinkage of the transferred flap must be borne in mind. To apply tension greater than that normally found in skin will result in partial or complete loss of the flap. The tension on the flap and surrounding tissue *must not exceed normal skin tension.*

The tube should be sufficiently long so that the defect may be easily reached by the flap. This eliminates the necessity of extra transfers. In the lower hemisphere of the face, the defect can be reached with the initial transfer (Plate II, fig. C). In the upper hemisphere of the face, it might be necessary to transfer the opposite end of the tube to another site, thus reaching the defect on the second "swing" (Plate III, fig. C).

A small hinge flap in the form of a half ellipse is usually turned back at a convenient recipient sitc to receive the elliptical flap of the tube. This increases the vascular bed and allows for more mobility for the tube and its flap on the second "swing" (Plate III, fig. C).

The width of the average neck tube is 4.5 to 5 cm., which allows for proper tubing without tension along the suture line. The length varies in every case, depending upon the distance to the defect, as mentioned above.

In constructing a neck tube of sufficient length to reach a defect on the first or second "swing", the midline can be crossed with impunity (Plate II, fig. A). This is in marked contrast to tube construction on the torso, where crossing the midline without leaving a central bridge is prohibitive.

In the longer neck tube, when the 3-to-1 length-to-width ratio is exceeded and when the circulation is questionable at some point along the tube, a central bridge will be required. This serves as a delay to prevent ischemia or poor venous return. We have found it advisable to be generous when tubing a

central bridge. The tube at that point should be greater in diameter than the rest of the tube, thus giving the appearance of an annular ring on an earthworm. This prevents constriction and circulatory embarrassment.

The principles involved in tube formation are the same for all tubes and have been discussed in an earlier paper from this service.[2]

The neck tube not only supplies necessary skin and subcutaneous tissue per se but in many cases also serves as a carrier for bringing additional neck skin to the face in the form of a flap. In transferring a flap, using the tube as a carrier, the number of delays cannot be over-emphasized. Few flaps can be elevated and transferred without both primary and secondary delays, and we have found that flaps measuring greater than 4 x 7 cm. on the neck will require a tertiary delay. The tertiary delay is most important in the stimulation of new capillary formation. The elimination of necessary delays in order to gain time invariably results in partial or complete loss of the flap. The delay is as important as any single stage in the plastic procedure.

All surgical incisions in the neck should conform to Langer's lines, which run transversely across the neck. The formation of a tube in a vertical direction on the neck will result in a bow-string type of scar which will, without question, later necessitate a Z-plasty for correction (Plate I).

CASE REPORTS

Case 1 (Plate II) struck by a mortar shell fragment, lost approximately two-thirds of the lower lip and skin and subcutaneous tissue over the right mandibular region Five cm of the right mandible were destroyed There was a continuous discharge of saliva from the mouth due to the extensive loss of tissue in this area

The problem of reconstruction was (1) the replacement of skin and subcutaneous tissue in the mandibular region, (2) reconstruction of the lower lip with its vermilion border, (3) mandibular bone graft, and (4) an extensive dental prosthesis.

Formation of a neck tube was accomplished on 26 May 1945 One month later a large flap measuring 7 x 10 cm was delayed primarily at the right end of the tube A secondary delay was performed 21 days later Since the loss of the lip was through and through, the flap was folded upon itself 21 days later to give the necessary two epithelial surfaces (Plate II, fig B) This procedure served as a tertiary delay The double layered pedicle flap was delayed along its distal margin 18 days later. Twenty-one days later, the pedicle was elevated and transferred to the defect Mucous membrane and scar at the floor of the mouth were used as a hinge flap to suture to the inner layer of the pedicle flap and to form the future labioalveolar sulcus, as well as an adequate bed for the future bone graft The distal end of the pedicle flap, which had been previously delayed, was opened along the suture line to receive a flap of mucous membrane reflected from the right cheek to furnish the necessary vermilion border (Plate II, fig C) Following two months' rest between stages, the tube was detached from the flap and was returned to the neck The patient received an iliac bone graft to the mandible one month later (Plate II, fig D) Adequate dental prosthesis was constructed Upon discharge, 15 months after admission to the hospital, the patient had a water-tight mouth and was able to eat a regular diet.

Case 2 (Plate III) received a severe shrapnel wound of the face, with a loss of both eyes and a complete avulsion of the nasal bones The infra orbital bone and nasal process of the maxilla were missing bilaterally There was a loss of two thirds of the inner aspect of the

[2] Split thickness graft—a useful adjunct in tubed pedicle preparation Macomber and Patton, SG&O, 84: 97–100, 1947

left lower eyelid, the right inner canthus was displaced inferiorly and there was a marked deviation of the nasal tip to the right and upward. Medial to the right inner canthus, there were small openings into the right antrum and posterior nares.

A neck tube was formed on 17 March 1945. With the usual time intervals, two delays were followed by a transfer of the tubed pedicle to the left cheek, using a hinge flap in this area to receive the pedicle. A pedicle flap measuring 4.5 x 8 cm. was delayed three times on the opposite end of the tube, and was transferred to the right infra-orbital region, with the base of the flap being placed at the future site of the nasal bridge. Hinge flaps were used to close the openings into the right antrum and posterior nares. At the same time, the right inner canthus was elevated into a normal position (Plate III, fig. C).

One month following the transfer of the pedicle to the right infra-orbital region, the tube was opened, the core removed, and the necessary tissue sutured into place across the nasal bridge and the left infra-orbital region. The left lower eyelid was reconstructed at the same stage. The remaining portion of the tube was discarded and the small hinge flap on the left cheek was placed in its previous bed. Preserved cartilage grafts were used for reconstruction of both infra-orbital ridges. An autogenous cartilage implant to the nasal bridge was performed at a separate stage (Plate III, figs. D, E).

Following placement of an ocular prosthesis, the patient was discharged 12 months after the initial stage of surgery was begun.

Case 3 (Plates IV, V, VI) received a shrapnel wound of the left face, producing a loss of the nasal process of the maxilla and the maxilla inferior to the infra-orbital ridge. There was an opening in the left nasolabial region 4 cm. in diameter. The nasal septum was destroyed and there was a perforation in the anterior hard palate 2 cm. in diameter. The anterior part of the alveolar process was completely missing, as were several teeth. On looking into the defect on the face, the entire left antrum was exposed. The right and left nasal cavities were converted into one chamber so that the opening into the right antrum could be clearly visualized. Through this same opening, the posterior pharynx and buccal cavity were clearly visible.

Temporary dentures with an attached palatal obturator were constructed to maintain normal contour of the upper lip and at the same time obliterate the palatal defect. This resulted in greater ease in eating and talking.

A neck tube was formed on 31 August 1945. At one-month intervals a flap was delayed primarily and secondarily at the left end of the tube. The pedicle was transferred to the left mandibular region on 16 February 1946, using the hinge flap previously described for its reception. This was followed by two delays on the opposite end of the tube. On 19 April 1946 the delayed pedicle flap was partially elevated and folded upon itself to give the epithelial surfaces for closing the palatal defect. An excellent blood supply to this double-layered flap was necessary to survive the potential infection following the transfer to the palatal area; therefore, a fourth delay was accomplished.

At the next stage (Plate V) the margins of the perforated palate were freshened. The posterior portion of the double-layered flap was sutured to the oral mucosa; the anterior portion was sutured to the nasal mucosa of the palate.

On 27 August 1946 the tube was divided and the distal end of the pedicle was reflected as a hinge to form the lining for the nasolabial defect and the new distal end of the pedicle was opened and advanced to form the outer closure (Plate VI).

Although the major portion of this patient's surgery is complete, further revision is necessary at the left nasolabial angle.

Case 4 (Plate VII) was struck by a rifle bullet, losing both ala, the columella and a portion of the bridge and nasal septum.

A neck tube was formed and a pedicle flap delayed primarily and secondarily on one end. The pedicle was transferred directly to the nose with the base of the pedicle flap at the site of the future nasal tip. Marginal hinges were turned in to form a portion of the nasal

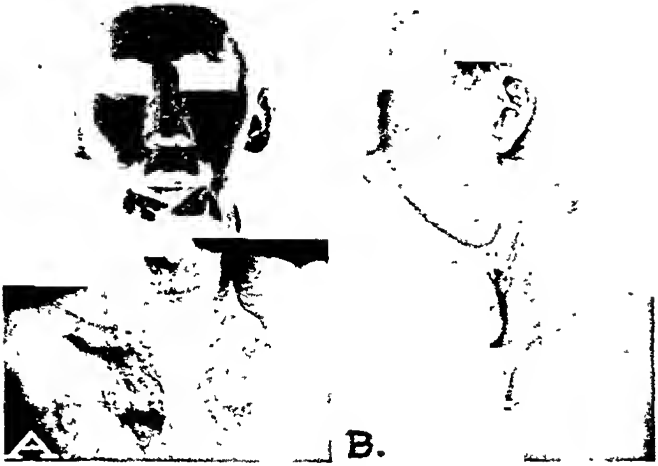

PLATE 1

FIG. A, left and B, right. Japanese prisoner shows neck tubes previously constructed at another institution. Neck tubes constructed vertically on neck producing typical bow-string contractures requiring secondary Z-plasties for correction.

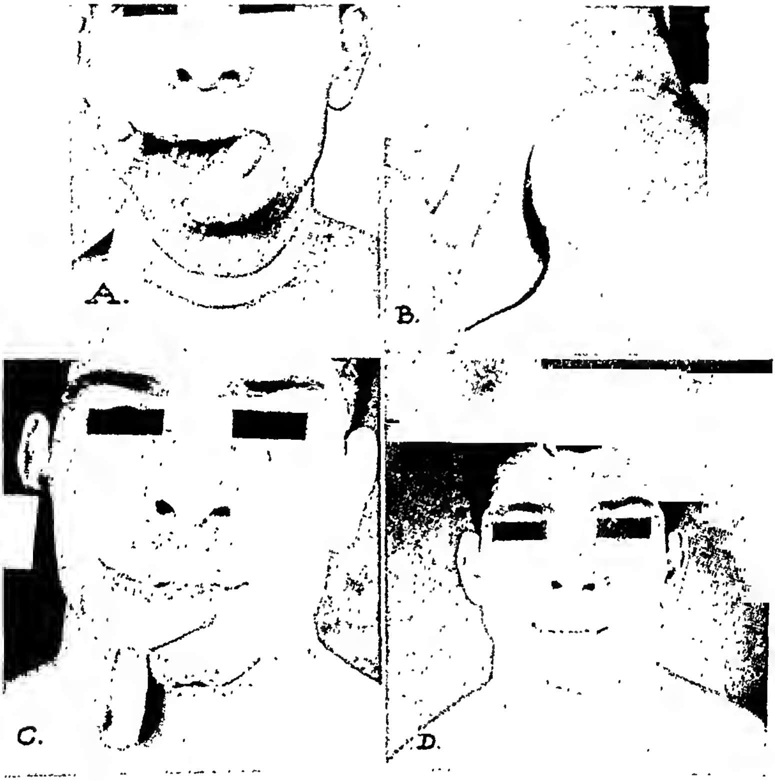

PLATE 2—CASE 1

FIG. A, upper left. Original defect of lower lip and mandibular region with neck tube formed.

FIG. B, upper right. Flap at end of tube delayed twice and then folded upon itself. Defect closed with split graft.

FIG. C, lower left. Pedicle flap transferred to defect. Vermilion border formed by use of mucous membrane cheek flap shifted into the split flap.

FIG. D, lower right. Results following revision, bone graft to mandible and dental prosthesis. Final revision of scar to be done later.

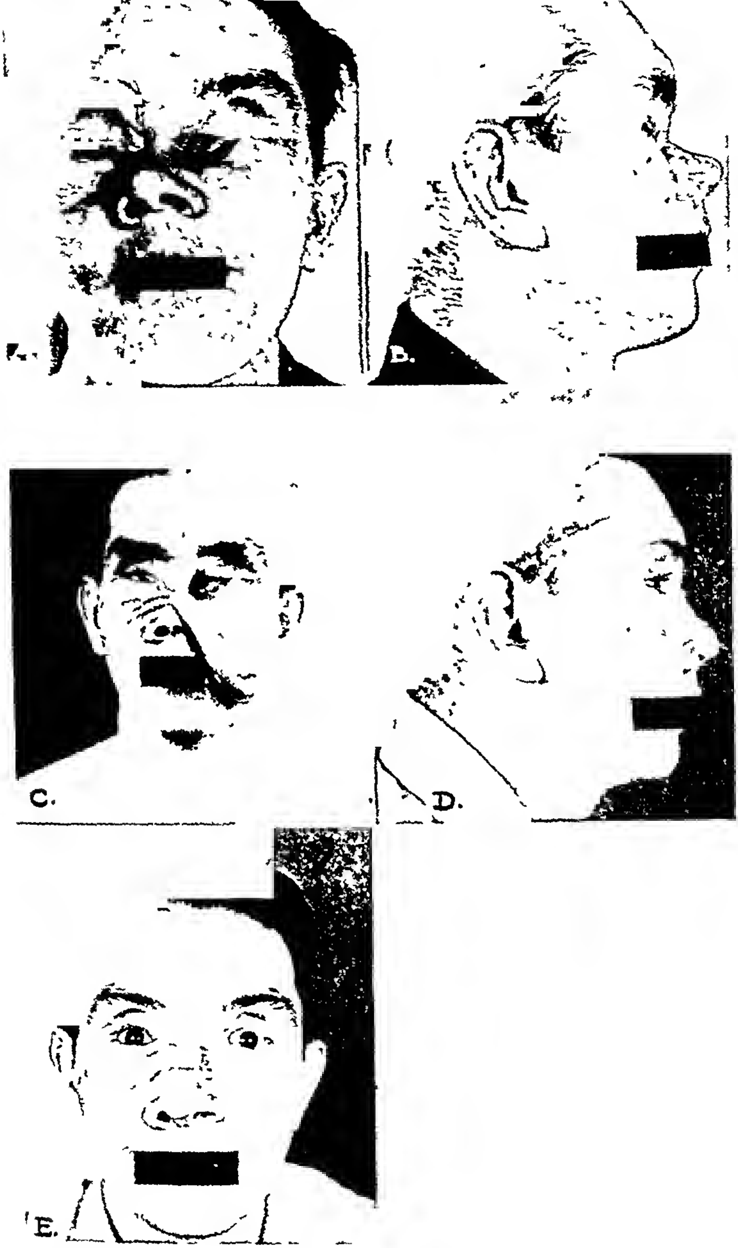

PLATE 3—CASE 2

FIG A, upper left, and B, upper right Shrapnel wound with loss of both eyes, avulsion of nasal bridge, both infra orbital ridges and nasal processes of maxilla Right inner canthus pulled inferiorly into defect by scar tissue Inner $\frac{2}{3}$ of left lower eyelid destroyed

FIG C, center left Tubed pedicle used to replace scar tissue in right infra orbital region and right side of nasal bridge with elevation of right inner canthus

FIG D, center right, and E, lower left Portion of tube used to reconstruct remaining nasal bridge, left lower eyelid and infra orbital region

PLATE 4—CASE 3

Fig. A, upper left. Defect into left antrum 4 cms in diameter Nasal process of maxilla and nasal septum destroyed converting nasal cavities and antrum into one chamber.
Fig. B, upper right. Neck tubed pedicle through defect to correct palatal perforation.
Fig. C, center left. Intra-oral view with pedicle in place.
Fig. D, center right. Proximal end of tube used to close nasofacial defect.
Fig. E, lower left. Eight weeks after division of pedicle and reflection of fat of pedicle to build out contour. Final revision of ala and scars to be done at a later date.

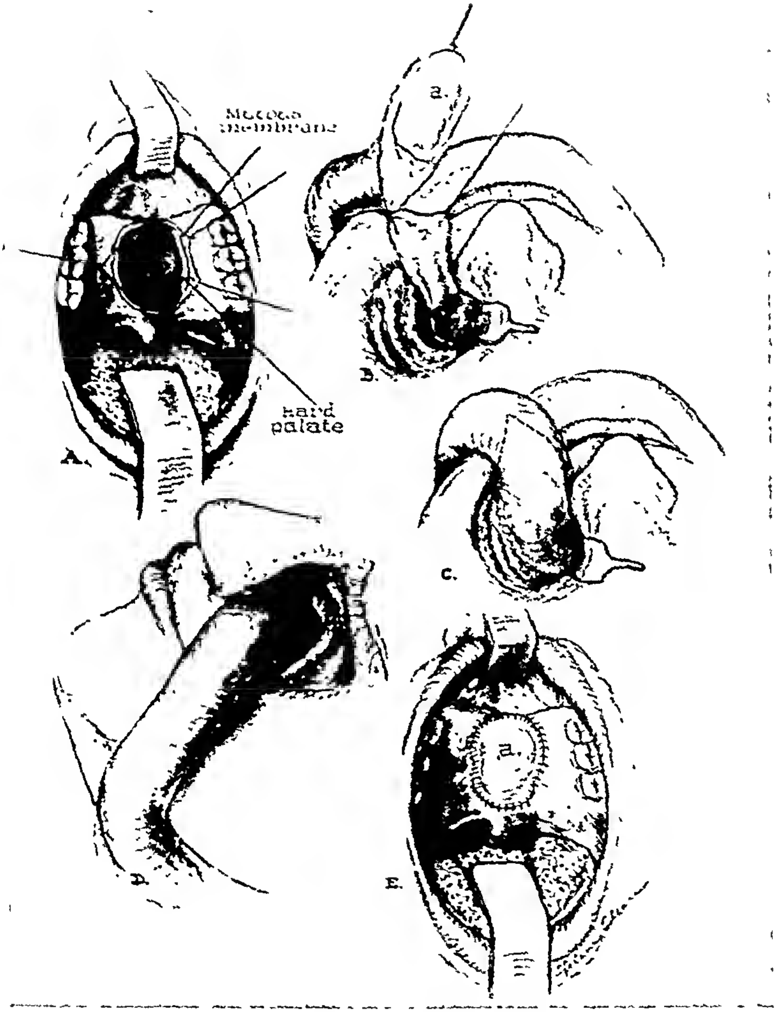

PLATE 5—CASE 3

FIG. A. Intra-oral view of palatal perforation with edges freshened.
FIG. B. Incisional defect at margin of nasofacial defect ready to accept the base of the pedicle flap. Note double-layered pedicle flap.
FIGS. C and D. Pedicle in place, base of flap sutured to incisional defect, double-layered pedicle flap sutured into palatal perforation.
FIG. E. Intra-oral view with pedicle closing perforation.

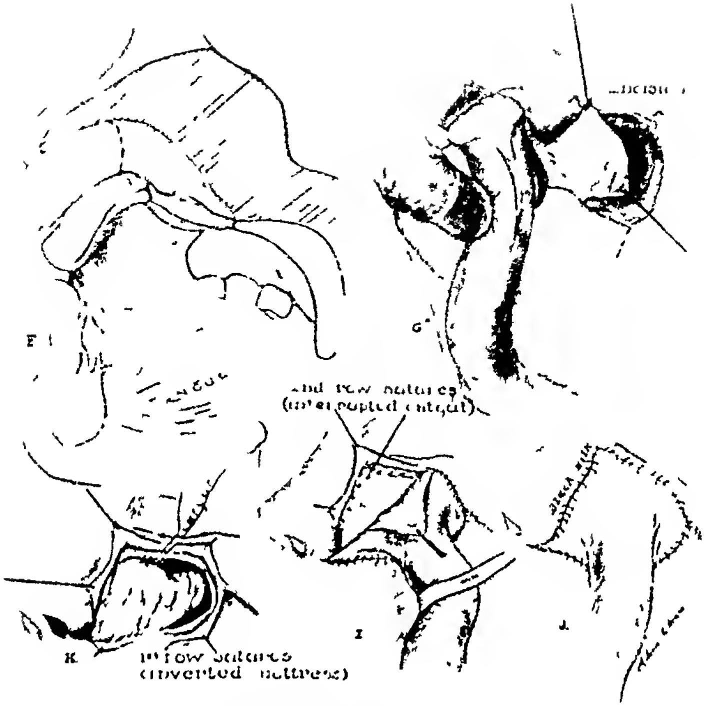

PLATE 6—CASE 3 *continued*

FIG F Modified sagittal section with tube in place

FIGS G and H Distal end of pedicle divided, opened and reflected to close inner layer of cheek defect

FIGS I AND J New distal end of tube opened and advanced to close outer layer of defect.

PLATE 7—CASE 4

FIG. A, upper left, and B, upper right. Loss of nasal tip, columella and part of both alae.

FIG. C, lower left, and D, lower right. Final results using neck tubed pedicle skin and cartilage graft for support to columella and bridge. Eight weeks post-operatively

lining. At the next stage the tube was opened and the two alae and columella were fashioned from the tissue of the tube. That portion of the tube remaining was discarded. Two months after the division of the tube, autogenous cartilage grafts were inserted to form the supports for a new nasal bridge and columella. The patient was discharged approximately 12 months after the initial stage (Plate VII, figs. C, D)

CONCLUSION

(1) The role that neck tubed pedicle skin has played in reconstructive problems about the face in battle-casualty type cases has been emphasized.

(2) Certain points important in the surgical technic were discussed.

(3) Representative cases were presented in example.

THE PLACE OF THE PROSTHESIS DEPARTMENT IN THE TEACHING HOSPITAL

ADOLPH M. BROWN, M.D.[1]

Chicago

Unfortunately, prosthesis construction is still a vital adjunct in modern surgery. The medical profession still requires the use of artificial substitutes for certain body parts, which may be missing, because of injury, disease, or life saving surgery.

Because most of the prostheses have been made by molding and casting techniques, the dental departments have generally taken over the work heretofore. This was natural for the dentists were more familiar with the waxes, plasters, and molding techniques than were other clinical workers.

But it is doubtful if the average clinician is aware of the tremendous strides the prostheses art has made in the past few years.

The early cases usually involved the replacement of a nose or ear. Such a prosthesis, the model of which would fit into the average bronze dental flask, could be easily molded in the vulcanite or vellum rubber used in earlier prostheses, lent itself to the thermoplastic technique of the dental laboratory.

Then came new materials. Newer metals made their appearance. Wipla metal, duralumin, and other dentists' metals were used, and the casting techniques began to show signs of variation. Copper, electrodeposited, was used for a time, and then, Lederer (1) introduced flexible prostheses. He utilized gelatin based materials to introduce new properties to the prosthesis. The new prosthesis was compressible and had some degree of flexibility and slight translucence. It could be molded to a flexible feather edge, but had to be replaced often.

Since thermoplastic, gelatin type prostheses required no after heat nor pressure, the casting technique became a simple pouring of the plastic mass. Thus larger molds became possible. The dental laboratory technique was no longer necessary, and dental equipment was no longer a vital adjunct for successful prosthesis work.

Newer problems of ablative and destructive types of surgery provided new challenges to the prosthesis laboratory. A published paper would invariably bring correspondence from a surgeon who had a patient with an uncorrected defect, similar to the ones illustrated, but with some differences. The correspondent would want to know if there was some known method of applying a prosthesis to the unusual deformity. Usually such a patient made his way to the prosthesis laboratory.

And this is the essence of the art of prosthesis. The surgeon doing this work soon realizes that the patient before him *has no where else to go*, because these patients cannot be made socially and psychologically presentable by surgery.

[1] Associate at the Eye and Ear Infirmary, University of Illinois, Chicago.

Prosthesis patients are beyond reconstructive surgery, either temporarily or permanently, depending upon the case, because of the debility of age or intercurrent disease, or because plastic surgery is inadequate or impossible.

But yet, the patient must be made esthetically tolerable to the public and to himself. Such a patient cannot be let to roam with his face bandaged up like a mummy. (We have seen some persons in this predicament.) Nor can he be sentenced to an isolated room in an infirmary. (We have seen some of this type, too.)

It is the true physician who cannot turn these patients away. Of course, artistic insight and some mechanical ingenuity are a help to the physician, and stubbornness of purpose and scientific curiosity are almost indispensable.

Once the profession began to realize that there was a method to conceal heretofore permanently hideous deformities, more and more patients were referred for prosthetic corrections. These were the type of deformities which formerly gave histories of having undergone ablative surgery, and of then being transferred from one department of the university clinic to the other, with no esthetic correction possible. Most of them drifted from clinic to clinic, hospital to hospital, becoming more depressed as the responsibility was shifted from one department to the other.

These, then, were the patients, and still are the patients, seeking prosthetic corrections.

Once the conception that prostheses had to be of a size containable in a dental flask was discarded, this branch of surgery expanded and is no longer the occasional side line activity of the dentist.

One would say today that prosthesis production is a blending of the sculptors art, the tricks o. molding and casting, surgery and engineering.

For today the prosthesis laboratory is called upon to fulfill tasks of almost all the other departments of the university and hospital, and its work already shows signs of interdigitating with them.

This can be best demonstrated by describing illustrative cases. Of course, since most objectionable deformities are about the face, the greatest number of cases are requests for artificial replacements for facial parts.

Reconstructive surgery of the ear has progressed enormously in the past few years, but still a prosthetic ear is more esthetically acceptable than a reconstructed one. A great number of prosthetic ears are made, sometimes after repeated failures in plastic reconstruction.

Noses are perhaps the most sought for facial prostheses, and nasal prosthetic problems, we think, deserve a special article (2).

Replacements for facial parts when the lips are destroyed require special attention. Here it is necessary that the artificial lips fit with very close approximation to the host tissue, for salivation is a problem to the lipless, or those who have gross lip defects. The saliva, once permitted to run off upon the skin, digests and macerates the skin surface, perhaps because of the enzymes, causing marked discomfort and annoyance. The problem for the prosthetist is to keep the saliva within the patient's mouth, as well as to replace the lips esthetically.

a b

FIG. 1a Traumatic loss of ear.
FIG. 1b. With ear prosthesis of latex.

a b

FIG. 2a Traumatic loss of entire nose. Repeated rhinoplasties failed.
FIG 2b Restoration with latex prosthesis.

For this purpose exact methods of molding and casting are necessary, the prosthesis must be as flexible and soft as possible, and should be preferably made of a synthetic rubber-like plastic. The prostheses made of natural latices are quite

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the oral mucosa and salivary glands be given to reduce salivation, but this causes too much discomfort to the patient. They prefer excess salivation to excess dryness of the mouth. Here, indeed, cooperation between the dental, oral surgery and prosthetic departments is needed.

Prostheses for loss of orbital contents are well established procedures already. Retinoblastoma surgery almost always results in a case for the prosthetist to create a substitute for the destroyed orbital contents, whether or not the cure is definitely demonstrated.

Here, cooperation between the prosthetist, ophthalmologist and artificial eye maker, is a necessity. We have found that artificial eyes of acrylic resin or glass are promptly and plentifully supplied by the commercial houses, and we

a b

FIG. 4a. Loss of great portion of face; tertiary syphilis.
FIG. 4b. Restoration with large prosthesis.

have not yet had to resort to making them ourselves. Yet, we are equipped to do it, if necessary. If the sinuses are exposed in the ophthalmic ablative surgery, the prosthesis performs a double function. It protects the exposed wound, lessening crust formation, at the same time that it offers esthetic comfort to the patient. Wounds involving the replacement of the orbital contents are often so large and involved that special large molds are needed, involving inlays of artificial eyes, artificial eyelashes, tiny conjunctival blood vessels of rayon yarn and special sunfast tints, as make-up for the artificial skin.

Orbital prostheses alone are justification for a special prosthesis department in the teaching hospital.

Aside from facial prostheses, there are other body substitutes which do now, and in the future will, even more, require a special prosthesis department in any medical school. I refer to the orthopedic department.

FIG. 3a. Facial destruction by consumptive facial disease. There is still a dispute as to whether the diagnosis here is American Leishmaniasis or syphilis. As first seen.
FIG. 3b. Facial hair clipped.
FIG. 3c. Prosthesis being placed in position. This is the largest facial prosthesis of which there is any record.
FIG. 3d. With prosthesis. Note the imbedded hairs to form a beard.

sensitive to oils and fats, and foods tend to make them deteriorate quickly. Therefore, it is easy to see that prosthesis construction about the lips requires special effort and ingenuity. It has been suggested that X-ray treatments of

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Even today, the prosthetist is called upon to create restorations for amputations of the hand. Amputees are no longer contented with glove covered restorations. They want the hand restoration to look like a hand. Instead of artificial hands covered with leather or cloth gloves, the patient is furnished with flexible, soft, skin-like hands with cuticle, fingernails, and even hairs (see illustration).

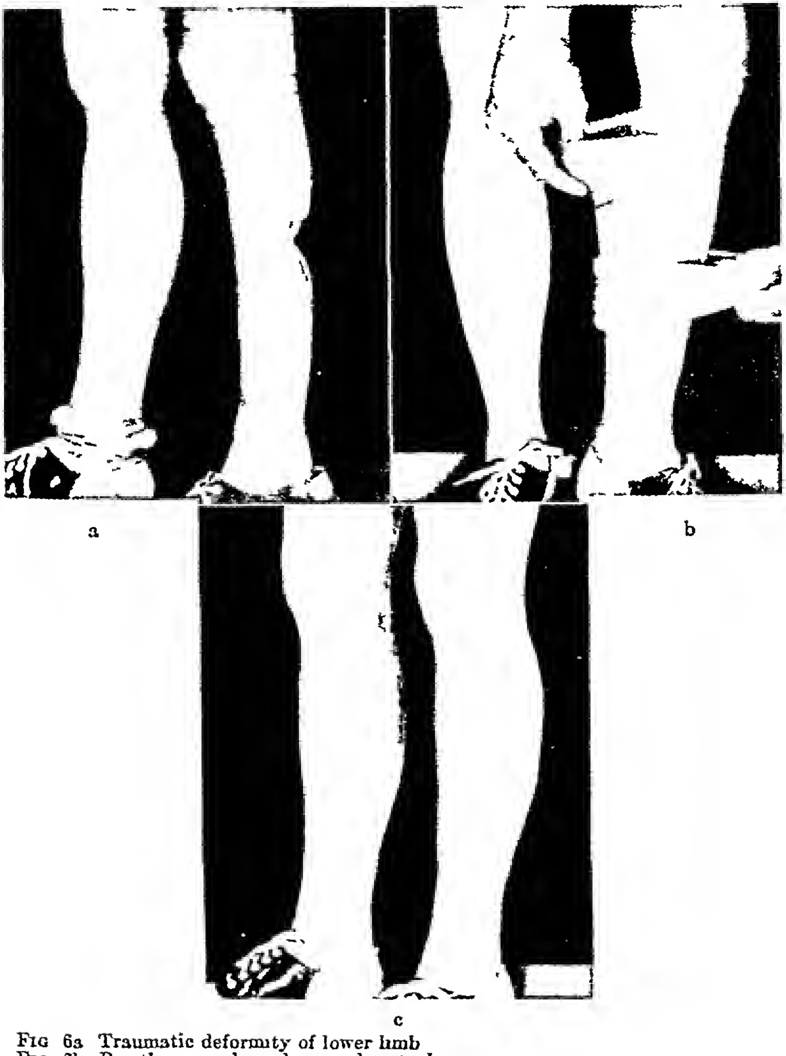
a

b

FIG. 5a. Partial amputation of hand. Note wrist watch disguising edge of prosthesis.
FIG. 5b. The hand prosthesis.

Another bond between the orthopedist and the prosthetic laboratory has to do with foot amputations. These are esthetic restorations, for occasionally a shoe must be adjusted to fit a partly amputated foot, or the atrophied foot of poliomyelitis. By the *exact* casting and molding methods of prosthetic technique, this is done so that the fit is as absolute as modern engineered molding and casting techniques can make them, using agar or algin materials instead of the

crude plaster bandage as a molding compound, and using casted foamed, frothy latex as the prosthesis material, instead of the wood and leather devices

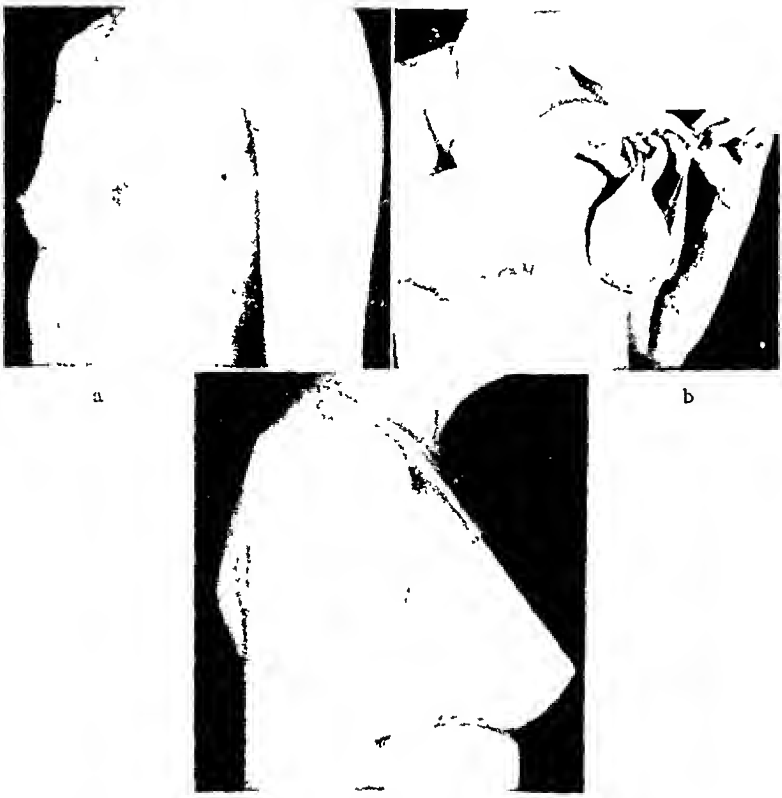


a b c

Fig 6a Traumatic deformity of lower limb
Fig 6b Prosthesis is slipped on under stocking
Fig 6c With sculpturally molded frothed latex prosthesis

ordinarily used to adapt the shoe to the amputation stump. Thus, people with gross discrepancies in size of feet, can be fitted with prosthetic devices which enable them to wear shoes symmetrically paired

Poliomyelitis deformities of the lower limb are also a problem involving the orthopedist and the prosthesis maker (5). Many female patients refuse to wear feminine attire, preferring slacks, in efforts to conceal their poliomyelitic atrophy. Frothed latex, sculpturally molded to match the lower limbs symmetrically, answers this purpose, although the technique still offers exasperating



a b c

FIG. 7a. Congenital atrophy of the breasts.
FIG. 7b. Prosthetic breast being placed in position.
FIG. 7c. Prosthesis in place.

difficulties. Yet these patients cannot be refused the esthetic improvement this stocking-like prosthesis offers.

The breast prosthesis is another esthetically desirable adjunct for the surgery of breast carcinoma. We have described these in two previous articles (3, 4), and surgeons already realize that this restoration, if offered to the patient, softens the postoperative psychic shock of this type of surgery

From this review of the diverse uses to which prostheses lend themselves

today, it is apparent that a university prosthesis department cannot be a particular subdivision, really, of any individual department, as the individual departments are now organized. A glance at the photographs is enough to convince that large prostheses, such as for arms, lower limbs, and breasts cannot be made in an ordinary dental laboratory. Nor can these prostheses be made in the medical art department, as this department is now constituted, for some phases of prosthesis construction require the attendance of a physician, and as prostheses improve, it is quite apparent that certain engineering procedures are necessary which are outside the sphere of the art department of the medical school. This conclusion also applies to the ophthalmology and otolaryngology departments of the medical school.

If, by necessity of administration, or because of lack of funds, the prosthesis department has to be under the wing of a medical school department already organized, it should be under the department of otolaryngology or of plastic surgery, because most prostheses are replacements for lost facial parts, or under the department of reconstructive and plastic surgery.

Nevertheless, a prosthesis department must be included as a division of a teaching hospital. Prosthetics cannot much longer be considered a stepchild of the practice of surgery. Construction of prostheses can no longer be a makeshift procedure.

The prosthesis department of a university hospital requires liaison not only with the referring department of the hospital, but also with other schools of the university, and with outside industrial establishments.

The other schools of the university of most aid to the prosthesis department are the departments of chemistry and engineering; these divisions are useful in a consultative capacity.

Industrial establishments of the larger and progressive kind are of infinite help to the prosthetist. Their engineers, chemists and research staffs generally need only be told of the prosthetic problem involved. These men are cooperation itself. They can be counted upon generally, to be intimately acquainted with all the physical and chemical properties of the product they produce.

Among these engineers, those associated with the rubber industry, the lacquer, synthetic resin and color and dye industries are those of most help in contemporary prosthesis art.

The prosthesis department is truly a meeting place for science, art and industry. It is necessary to correlate the offerings of many occupations to synthesize a prosthesis.

The prosthetic art has advanced with other branches of surgery. For the future, prostheses will improve faster than ever before. The final restoration material will not long remain rubber or simple synthetic resins. Prosthetic restorations of tomorrow will not be limited in physical and chemical nature. Synthetic materials will be compounded to meet almost any set of properties desired.

We must also remember that when we incorporate the newer compounds into any technique for prostheses, we immediately place ourselves in a position

to profit by the vast research done all over the world in the growing field of chemical plastics. We literally obtain the aid of thousands of chemists and engineers, for every gain in the field of synthetic plastics is a possible gain in the field of plastic surgery based on a technique incorporating plastic resins as restorative materials.

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NOSE FRACTURES TREATED WITH THE RHINOTRACTOR

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Clinica Mexicana de Cirugia Plastica y Traumatologia, Mexico, D. F.

The treatment of simple fractures of the nose is easy. It is enough to reduce the displacement by intranasal route with a strong blunt dissector while the other hand controls from the exterior the position of the fragments, a mold of dental stent being applied afterward to protect the nose from incidental trauma and to avoid excessive edema.

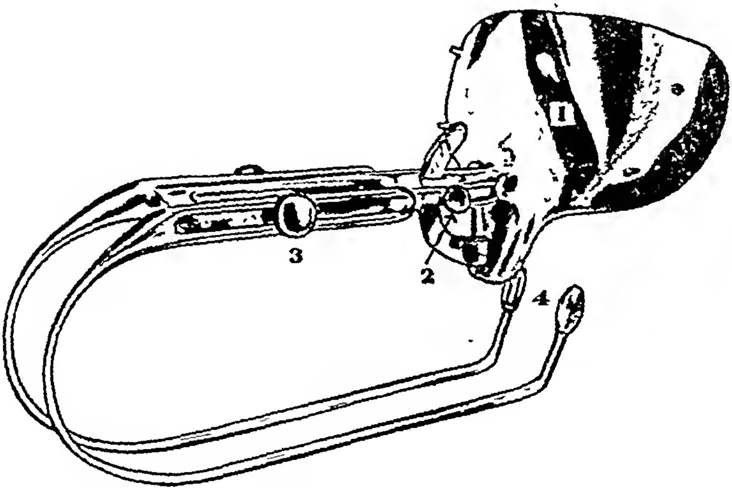

FIG. 1. RHINOTRACTOR

1. Base which is fastened to the frontal region. 2. Knob to fix the mobile trunk at the desired projection. 3. Knob to fasten the splints in place. 4. Post-nasal olives which support and immobilize the nasal bones.

Comminuted fracture with considerable displacement of the fragments presents a problem which should be handled in a different manner:

In some fractures, the bony fragments are small and the relation among them totally lost. Fixation after reduction in these cases is not easy and position frequently is altered in the postoperative period by occasional trauma and retraction phenomena which follow the fibrous stage.

Thus, in compound fractures it is necessary to provide the restored bones with a splinting mechanism which inmobilizes them during the reparative stage.

With this object in mind we have constructed a device which supports the nasal bones from the interior of the nose, thus avoiding any posterior displace-

ment. With it we try to eliminate the disadvantages of the splints used to date, make it compact, easy to sterilize and to handle and with wide possibilities for using it in any type or size of face (figs. 1 and 2).

The appliance does not obstruct inspection of the nasal cavity and does not interfere with any kind of treatment, thus permitting ease and comfort for the patient and makes it simple for the surgeon to treat any congestion or infection without interfering with normal breathing.

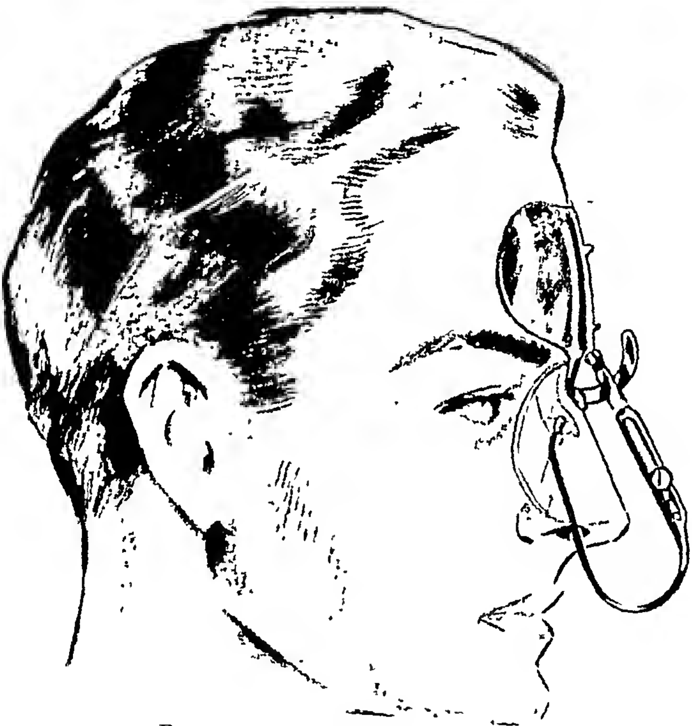

FIG. 2. RHINOTRACTOR IN PLACE

The fact that the splints are of the same size and bilateral implies that when fastened in they are symmetrical, and the position of both nasal bones will be concomitantly symmetrical.

APPLICATION

1. The base of the Rhinotractor is held against the forehead, over a cotton pad, with an elastic bandage (fig. 3).
2. Anesthesia: Ether-oxygen with pressure or sodium pentothal (fig. 4).
3. (Under aseptic technic.) Reduction of fragments with a strong dissector

FIG. 3 THE RHINOTRACTOR IS FIRMLY ATTACHED TO THE FOREHEAD WITH AN ELASTIC BANDAGE TISSUES ARE CLEANED AND STERILIZED, PLACED

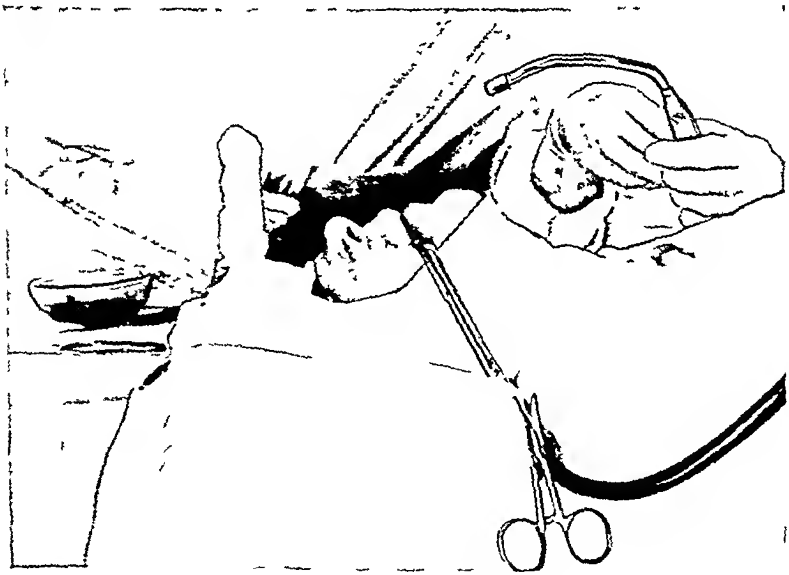

FIG 4 ANESTHESIA WITH ETHER OR PENTOTHAL SUCTION READY

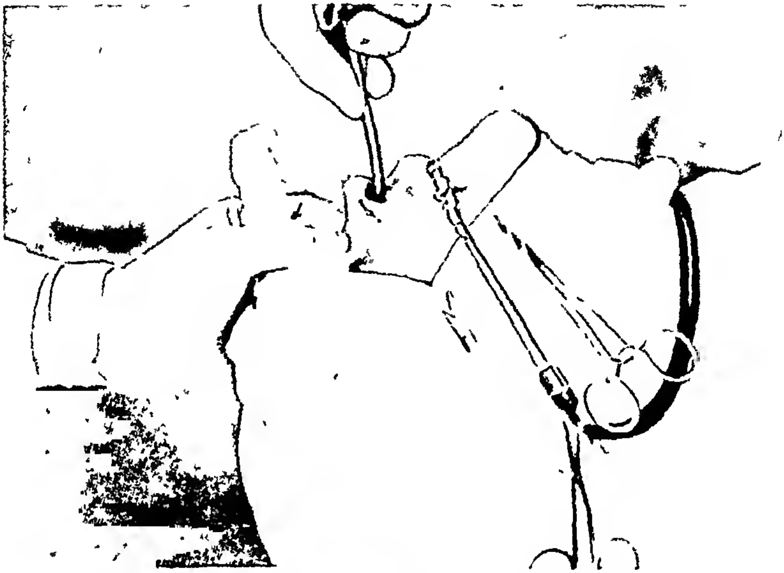

FIG. 5. THE NASAL BONES ARE RESTORED IN PLACE WITH A BLUNT DISSECTOR OR A CURVED FORCEPS

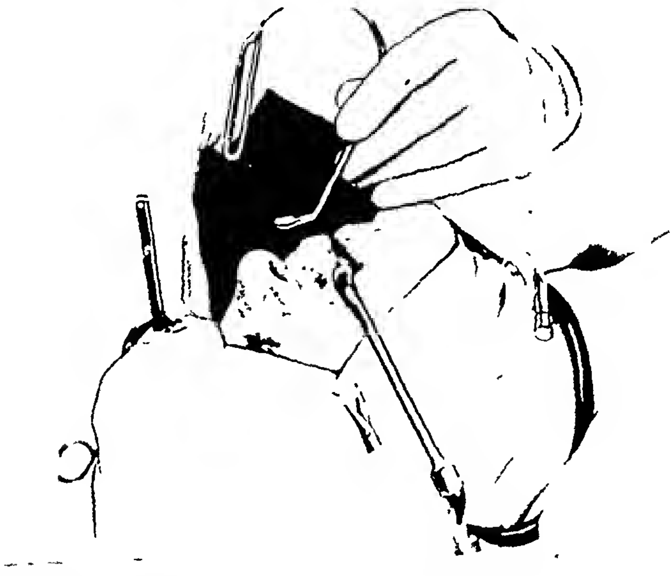

FIG. 6. SPLINTS ARE INTRODUCED SEPARATELY AND FASTENED IN PLACE WITH THE KNOB

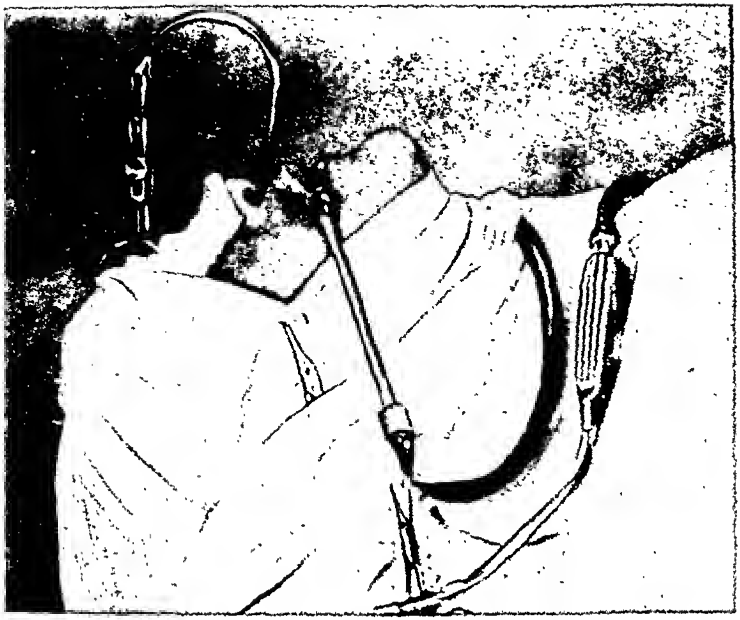

FIG. 7. GAUZE AND DENTAL STENT TO AVOID EDEMA

FIG. 8. RHINOTRACTOR IN PLACE

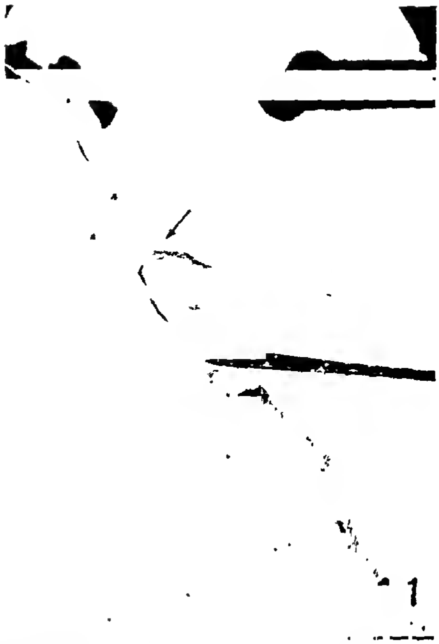

FIG. 9. X-RAY PICTURES SHOWING FRACTURES OF THE NOSE IN WHICH THE REDUCTI
HAS BEEN MADE AND THE RHINOTRACTOR APPLIED

FIG. 10

FIG. 11

FIG. 10. FRACTURE 23 DAYS OLD, BEFORE REDUCTION

FIG. 11. A FRACTURE 23 DAYS OLD, IN WHICH REDUCTION HAS BEEN MADE, HOLDING TH
BONES IN PLACE BY MEANS OF THE DEVICE HERE DESCRIBED

or a curved forceps. Thumb and ndex of left hand control from the outside the fragments presented by the dissector (fig. 5).

4. Splints are introduced, applying the olives to the posterior aspect of the nasal bones. They are held in place and fastened when their position is symmetrical.

5. Holding the left hand over the nasal bones the desired height is obtained, then it is secured in position with the knob (fig. 6).

6. Gauze pad and dental-Stent mold are placed over the nose and held in place with adhesive bands (figs. 7 and 8).

7. The required local treatment is begun.

8. The Rhinotractor can be retired in 6–10 days. By this time the fibrous callous is sufficiently strong to hold the fragments firmly in place.

50 cases in which this device has been successfully used with good morphological and physiological results have justified and stimulated its use.

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November 1947

INTERNATIONAL ABSTRACTS OF PLASTIC AND RECONSTRUCTIVE SURGERY

GRAFTING

Brown, James Barrett: The Closure of Surface Defects with Free Skin Grafts and with Pedicle Flaps. *Surg Gynec Obst* 84 862, Apr 15, 1947

In a brief discussion of the role of the free skin graft and the flat pedicle flap in the field of plastic surgery in World War II, Brown makes the following essential point "In late deformities with surface scarring and with defects of nerves, tendons, bones and joints, it is essential to obtain adequate surface healing with a flap before satisfactory deep restoration can be done The deep healing can be no better than the sur ace healing "

This statement is indicative of the trend in the orthopedic and neurosurgical treatment of such defects, a trend which has become especially evident since the advent of the sulfonamides and penicillin

Brown writes of having seen patients with wire, foil, screws, plates, bone grafts and bone fragments protruding through wounds that did not have adequate surface healing By removing dead and foreign material, dissecting scar tissue back until a minute blood supply is available and repairing with a flap of suitable thickness, the deeper tissues can be approached through viable tissues that will heal promptly and protect whatever repair has been carried out in the underlying nerve, tendon, bone or joint

In the treatment of burns where the employment of free skin grafts has been most extensive, the principle of waiting for spontaneous healing has been replaced by the

ANNOUNCEMENT

The American Society for Surgery of the Hand will meet in Chicago on January 23 and 24, 1948, in conjunction with the American Academy of Orthopedic Surgeons. Visitors are welcome at the scientific session. The Preliminary Program follows

"Volkmann's Ischemic Contracture, Local in the Hand": Sterling Bunnell, M.D., San Francisco, California.

"Tendon Grafts as a Substitute for Flexor Tendons": Sumner L. Koch, M.D., Chicago, Illinois.

"Tendon Transfers and Arthrodeses in Combined Median and Ulnar Nerve Paralysis": J. William Littler, M.D., New York City.

"Initial Treatment of Hand Injuries: Some Common Errors": Condict W. Cutler, M.D., New York City.

"Transplantion of Metatarsals to the Hand to Replace the Metacarpal": Walter C. Graham, M.D., Santa Barbara, California, and Daniel Riordon, M.D., (by invitation).

"Metacarpal Transfer for Improving the Function of the Crippled Hand": Gilbert L. Hyroop, Lt. Col. (M.C.), Battle Creek, Mich.

"Tenosynovitis of the Extensor Carpi Ulnaris Tendon Sheath": Clarence A. Luckey, M.D., Oakland, California.

"Experimental Study of Cellophane in Prevention of Adhesions After Tendon Suture": William H. Requarth, M.D., Chicago, Illinois.

"Z-plasty vs. Free Skin Graft for Correction of Volar Skin Contractures of the Hand": William H. Frackelton, M.D., Milwaukee, Wisc.

"Tumors of the Hand": Michael L. Mason, M.D., Chicago, Illinois.

"Mobilization of Stiff Finger Joints": S. Benjamin Fowler, M.D., Nashville, Tenn.

"Report of the Committee on Rehabilitation": Donald B. Slocum, M.D., Eugene, Oregon.

"Opponens Transplant": John W. Kirklin, M.D., Rochester, Minn. (by invitation).

"Sympathetic Surgery for Lesions of the Upper Extremity": C. Hunter Sheldon, M.D., Pasadena, California (by invitation).

"Presentation of Cases": Sumner L. Koch, M.D., Michael L. Mason, M.D., and Harvey S. Allen, M.D., Chicago, Illinois.

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Editorial Comment: This courageous approach represents a positive solution for many cases of deep burn, but very sound and thoughtful surgical judgment must be exercised to permit the safe application of extensive surgical excision with immediate adequate grafting. Several of the numerous colored plates show the excellent pliability and function of split grafts following excision in contradistinction to the increased scar from secondary grafting of granulation areas. As a minor point, the reference to multiple large split grafts placed to cover a leg, as a "stocking graft," does little more than add another confusing term to a literature already overhurdened with amhiguous descriptive titles for skin grafts.

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The loss of a thumh, as Kelikian and Buitcliffe remind us, deprives the hand of most of its usefulness. Without the thumb the fingers cannot hold and use a pen with skill and speed, and tools cannot he used efficiently.

A reconstructed thumb must move in and out of oppositional position, abduct, flex and touch the other finger tips. It must have sensation and convey stereognostic sense.

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(1) Examination: (a) Wound inspection, (b) the index finger is examined for sensation and power of flexion, (c) roentgenogram of the hand taken, and (d) the hand and forearm washed with soap and water, wrapped in sterile dressings, splinted and elevated.

(2) Preparation of a pedicle tube or flap and revision of the wound of the hand: A tube or flap is raised on the abdomen. A hand wound is revised and covered with fine mesh gauze. The hand and forearm are encased in a snug skin cast, with fingers free. A banjo splint is incorporated and fingernail traction instituted at night but the fingers left free by day.

(3) Deepening the weh space hetween the index and long fingers: This is done when the abdominal pedicle is ready. The space deepened 3 cm. The deepened weh space is covered with the ahdominal flap.

(4) Release of the hand from the abdomen, covering the original wound, removal of scar bound skin and its replacement with padded skin: Scar excision is done. The other end of the pedicle is used for coverage. A snug circular cast with fingers free is used at this time.

(5) Osteosynthesis and rotation of the index finger into a position of opposition. Osteotomy of the second metacarpal is done. The distal fragment of the second metacarpal is coned and inserted into a cavity hollowed into the greater multangulum. The two bones are fixed with wire. The severed ends of the ahductor pollicis longus are anchored to the distal fragment of the second metacarpal bone. The incision is closed.

Kirschner wire is passed through the distai phalanx of the abducted index finger. It is connected to a special rotation splint incorporated in the cast. In the next 2 weeks the transposed index finger is gradually rotated in a clockwise direction until it comes to face the long finger; it is then held immobilized.

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EYE

Kohout, J. J., and Callahan, A.: Ophthalmopedics. *Am. J. Ophth. 29:* 968, Aug. 1946.

Kohout and Callahan describe various mechanical devices made of the plastic methyl methacrylate ("acrylic") which they found useful at an army general hospital. The devices served as conformers in the socket after enucleation, as implants, as socket stretchers, to help smooth out skin grafts, and to diminish eyelid edema.

Marcks, K. M., and Zugsmith, G. S.: Plastic Repair of Deformities of the Socket and Minor Defects about the Orbit. *Arch. Ophth. 36:* 55, July, 1946.

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less time-consuming principle of getting the wound healed as soon as possible by means of free skin grafts. In this way, pain, contractures, fixation of joints and chronic shock are diminished or prevented. Raw open areas as large as 200 square inches have frequently and successfully been grafted at one operation. In the early closure of defects of the hands, the results of free grafts have been especially dramatic.

Another area notably responsive to the use of free grafts is that of the eyelids. A special type of graft that is adaptable in function as well in color has been used hundreds of times by Brown. Such a graft is of full thickness and is taken from the supraclavicular region. Although the supply is limited, this location affords the best color match and, presumably, from its position in the platysma area gives excellent function.

In locations for which free grafts will not suffice, as in cases where features are lost, the flat pedicle is used. One of the chief uses is in repair of defects of the hands and arms. The author states that this method *may* be considered the opposite of amputation.

Cope, Oliver, Langohr, John L., Moore, Francis D., and Webster, Richard C.: Expeditious Care of Full-Thickness Burn Wounds by Surgical Excision and Grafting. *Ann. Surg. 125:* 1, Jan. 1947.

As pointed out by Cope and his colleagues, burns of partial skin thickness are treated well by protective ointment dressings, but full-thickness burn wounds have always presented a challenge to the surgeon. In deep burns the usual protective barrier of the epidermis is broken, permitting early infection of this coagulated and devitalized tissue, which has lost all means of communication with the protective body fluids. In these patients successful closure of extensive areas is delayed interminably, and severe malnutrition may complicate convalescence. Prompt surgical excision of the dead tissue with immediate closure by adequate skin grafts will preclude infection, minimize scar disfigurement and contracture, greatly shorten the period of hospitalization and speed the rehabilitation of the seriously burned patient.

In a series of 52 cases Cope *et alii* treated full-thickness burn wounds by expeditious surgical excision and grafting, with most gratifying results in those cases of circumscribed full-thickness loss which could be grafted within a few hours after injury. Despite the administration of systemic chemotherapy, more infection was apparent in those wounds where excision with graft closure was delayed for several days. In extensive full-thickness burns homeostasis has been maintained effectively to permit early excision and grafting of certain areas. The care of remaining portions of the burn was postponed because of precarious homeostasis and lack of sufficient donor skin for grafting. This necessary delay in closure has yielded some good results, but usually the longer the delay, the greater has been the infection, with corresponding poorer takes of the grafts and more disabling scar.

The success of this method of treatment depends upon the appreciation and evaluation of several important factors. The assessment of the depth of destruction, in distinguishing full-thickness from partial thickness burns, requires discriminating observation of the appearance of the skin, the state of its circulation, the sensation of the skin, and the position of the burn. This problem resolves itself finally with increasing experience in practice. In surgical excision of a circumscribed area when there is any doubt as to the depth of destruction, it is wise to err by exaggerating rather than depreciating the depth. In extensive burns, however, a more conservative attitude must be assumed since the general condition of the patient will permit less surgery, and often only meager amounts of donor skin are available.

The authors found chemotherapy valuable in controlling infection in those cases where excision and grafting had to be delayed. When excision and grafting could be performed within a few hours of injury chemotherapy was probably superfluous. A considerable loss of blood from excision is admitted, but it can always be replaced and therefore is no contraindication to the immediate surgical elimination of the burn slough. The problem of achieving homeostasis early has been made more complicated by immediate excision and grafting, but the elimination of infection, better nutrition and early healing have more than compensated.

It is difficult to convince any but the plas-

tic surgeon that the best base upon which to place a graft is the one freshly exposed after excision of the burn slough, even though the tissues be edematous

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Marcks, K. M., and Zugsmith, G. S: Plastic Repair of Deformities of the Socket and Minor Defects about the Orbit. *Arch Ophth 36* 55, July, 1946

Marcks and Zugsmith discuss 4 types of sockets, namely, that resulting from simple

enucleation, enucleation with implant, simple evisceration, and evisceration with implant Subsequent changes in the socket result from atrophy of fat, from gravity, and relaxation of check ligaments and muscles, together with changes in the conjunctiva The chief resulting deformities are deepening of the superior orbito palpebral sulcus and a tendency toward obliteration of the inferior sulcus

The severely contracted socket requires complete reconstruction, Wheeler's method of completely relining the socket with a thin Thiersch graft being used Mareks and Zugsmith prefer to do a two stage operation by first relining the cul de sacs, including the posterior surface of the eyelids, and lining the posterior wall at a second operation They again stress the importance of thin lids, removal of scar tissue and dissection to the periosteum on each side and below, with preservation of the caruncle

For absence of the lower cul de sac only, they prefer a mucous membrane graft taken from the lip and stress the importance of gaining attachment of this graft to the periosteum of the floor of the orbit

If there is a redundancy of conjunctiva below but no cul de sac, the authors recommend anchoring this conjunctiva to the periosteum of the lower margin, using a dissection through the conjunctiva down to the rim The conjunctiva is held down to the rim by sutures through the edges of the conjunctival incision, through the periosteum and tied on the skin surface over vaseline gauze At times, they found it necessary to use a thin Thiersch graft when a large portion of the socket was contracted, leaving some normal conjunctiva in the socket They feel that the excess secretion produced is gradually reduced

For mild relaxation of the lower eyelid, exercise of the orbicularis of the lower lid is recommended For more severe relaxation the Kuhnt Szymanowski operation is advised

Sugar, H. S, and Forestner, H. J.: Methacrylic Resin Implant for Sunken Upper Lid Following Enucleation. *Am J Ophth 29* 993, Aug 1946

Sugar and Forestner describe a simple method for introducing a methyl methacrylate implant into the upper portion of the upper lid to fill out the sinking which sometimes occurs after enucleation of the eyeball The implant is of curved pickle shape, about 28 mm long Twenty cases with satisfactory results are reported Experiments and a review of previous experience are cited to indicate the lack of untoward results from the implantation of this material

MacKensie, C. M: Choice of Grafts for Orbital Reconstruction. *Am J Ophth 29* 867, July, 1946

The use of mucous membrane from the mouth, vagina, prepuce, rectum or nose for reconstruction of the markedly contracted eye socket is preferred by MacKensie Two illustrative cases are presented, one in which a satisfactory socket was obtained by a graft of rectal mucosa, the other in which mucous membrane from the prepuce was used

Givner, I.: Reconstruction of the Floor of the Orbit. *Am J Ophth 29* 1010, Aug 1946

A case of marked depression of the eyeball with enophthalmos from fracture of the floor of the orbit well is described by Givner Reconstruction was carried out by a graft of preserved rib cartilage on the floor

NOSE

Editorial Comment on the Literature Dealing with Nasal Reconstruction Among the significant communications which appeared in the medical literature during the second half of 1946 were those covering the use of composite grafts The utilization of these transplants in the repair of subtotal losses was one of the most important contributions to plastic surgery during the recent war

Another subject which has been widely discussed in rhinological literature, often unnecessarily, is "the plastic reconstruction of the septum"

These two subjects are of particular interest to the general plastic surgeon as well as to the rhinologist who confines himself to rhinoplastic procedures

As far back as 1902, Konig (*Berlin klin Wchnschr*) described a new method of repair of full thickness losses about the tip of the nostrils by a free composite graft (two layers of skin with cartilage between) from the he

lix. In 1912, Joseph (*Handbuch der Speciellen Chirurgie d. Ohres u. oberen Luftwege*) reported the use of free section of a normal ala for repair of a defect of the opposite nostril. In 1914, Konig (*Bruns Beitr. z. klin. Chir.*) reported 25 successful transfers in a series of 47 free composite grafts from the helix for defects of the tip and nostril. He referred to only "one or two" successful results observed by von Enderlen in 5 instances of repair of the nostril by a composite graft from the ear lobe, and be ascribed the failures to the luetic origin of tbe defects.

It was not until tbe publications of Brown *et alii* (1946) and Dupertuis (1946), who used the composite grafts in a large number of selected cases with a good surgical technic, that the procedure became known and accepted as most valuable in nasal reconstruction. Tbe fact that Brown and Dupertuis used tbe composite grafts independently and without previous knowledge of existing communications on the subject is additional evidence of the great need for accurate reviews of specialized foreign literature. Had not tbe reports of Konig (1902 and 1914) remained unknown to most plastic surgeons during World Wars I and II, tbousands of war injured might have enjoyed better end-results through simpler procedures.

Tbe interest of rhinologists in rhinoplastic procedures is of scientific as well as practical value. Let us hope that it will be maintained on a bigb level. The same applies to tbe general plastic surgeon, who will have to master the rhinological procedure in rhinoplasties in order to attain maximum efficiency. We must consider, witbout prejüdice, tbe interest of tbe rbinologist in reparative surgery to be advantageous to everyone concerned, provided be receives adequate training in reconstructive procedures in addition to acquiring the particular skills of his specialty. Unfortunately, this does not always occur, and as yet too little stress is placed on the postgraduate training of the rhinologists who venture into the field of reconstructive surgery.

Much misleading material has heen published lately in the field of nasal reconstruction and particularly on "new trends" in reconstruction of the septum. It is tbis reviewer's helief that the authors of such papers must assume a greater moral responsibility for the accuracy of their statements, not only toward the prospective reader but also toward tbe patient upon wbom the proposed surgery may be performed. The editors must also share in this responsibility. Some of the writers on septal reconstruction challenge the universally accepted anatomicopatbological facts of tbe nasal structures and substitute mathematical calculations for anatomical facts.

One of the new, much popularized ideas is that the septum is not required for tbe support of the nasal framework and consequently can be excised in a submucous resection and reinserted between the mucopericbondrial flaps only to prevent scar retractions. The fact remains that septal deformities requiring repair are usually of traumatic origin, and more often than not the malformation involves the vomer as mucb as the septal cartilage. It is generally accepted by outstanding authorities in the rhinological field that there are *areas of safe septal excision*, based on the position and interrelationship of the septal cartilage in reference to the external framework. The anterior septal cartilage should always be left *in situ* along the columella and along the cartilaginous dorsum, in sufficient amount to prevent tbe breaking down under the slightest trauma. The subject was well covered lately in a number of communications (Maliniac, 1945; Steffensen, 1947).

Lamont, E. S.: Physiology of the Nose and Its Relation to Plastic Surgery. *Am. J. Surg. 72:* 238, Aug. 1946.

Lamont presents tbe physiological aspects of rhinoplasty, including the normal physiology of the nose, postoperative sequelae and septal reconstruction.

Postsurgical pathological changes often occur in the narrow portions of the nasal passages where most of the incisions were made. Miminal scarring is therefore essential and is obtained by closure of the raw surfaces.

Lamont does not perform a suhmucous resection together with external nasal reconstruction. He describes resetting a deflected and subluxated septum through excision of cartilaginous segments along the angle of deflection.

Editorial Comment: Excessive cicatrization and scar contracture ohserved following

rhinoplastic procedures are usually due to excision of vestibular lining and exposure of raw surfaces. Postoperative endonasal adhesions cause severe interference with breathing as well as retraction of tip cartilages. To prevent this the vestibular skin should not be removed, and all endonasal incisions should be thoroughly closed.

The timing in the repair of concomitant septal and external deformities is usually based on the following findings: If the deflection is such as to interfere with the successful performance of a corrective rhinoplasty, it should be repaired prior to, or simultaneously with, the latter. On the other hand, where there is a pronounced deflection of the vomer as well as a large osteocartilaginous hump, the posterior bony submucous resection should be done in a separate stage following external nasal reconstruction. Otherwise, the freely mobilized bony bridge, detached along the frontal and maxillary suture lines, may sink down. In such cases, during the rhinoplastic procedure partial relief from obstruction could be secured by partial resection or resetting of the anterior septum.

Young, Forrest: The Repair of Nasal Losses. *Surgery 21:* 670, Nov. 1946.

Methods of reconstruction in nasal losses are discussed by Young. He briefly outlines the surgical anatomy of the nose, describes its functions as well as the relationship of the nose to the facial contour and stresses the supporting role of the septum in maintaining the lower dorsum.

A nasal lining provided by full-thickness skin is unsatisfactory because of maceration of the epithelium and the presence of sweat and oil glands. A thin skin graft is preferable for this purpose although there is often contraction of the graft.

Nasal losses were repaired by forehead flaps in 5 stages; a neck flap was also used.

THROAT

Ladd, William E., and Swenson, Orvar: Esophageal Atresia and Tracheo-Esophageal Fistula. *Ann. Surg. 125:* 23, Jan. 1947.

Esophageal atresia and tracheo-esophageal fistula have received little recognition until the last decade. Ladd and Swenson quote Sir G. Gray Turner, who has recently estimated that this malformation occurs about as frequently as harelip and cleft palate deformities.

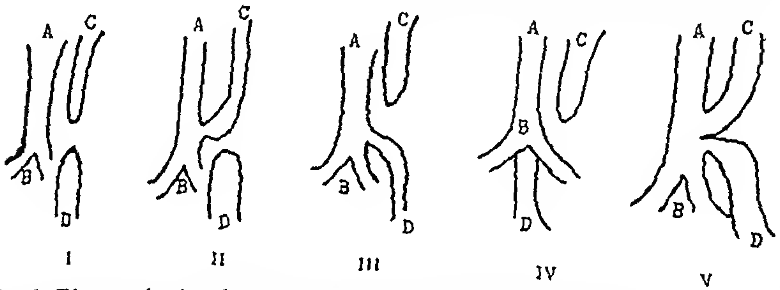

Fig. 1. Diagram showing the arrangement of the trachea and esophagus in the various types of esophageal atresia and tracheo-esophageal fistula. The letters refer to the following structures: A, trachea; B, bifurcation of trachea; C, upper segment of esophagus; and D, lower segment of esophagus. (From *New England Journal of Medicine,* 230: 625–637, May 25, 1944.)

The pathology of this condition may be roughly divided into 5 types, as shown in the diagram.

Clinical findings and details of roentgenologic examination are clearly discussed. The latter will help the surgeon to determine the preferable plan of treatment.

The authors' detailed preoperation will often improve the patient's condition sufficiently to make an operation successful which would otherwise end in disaster.

All attempts to remedy esophageal atresia

and tracheo-esophageal fistula without direct ligation of the fistula have failed. The retropleural approach through the right back is used. If the space between the two segments of the esophagus is much over 2 cm., the possibility of doing an anastomosis without tension is not good.

In patients in whom the ends are too widely separated to warrant primary anastomosis, a multiple-stage procedure is adopted. The first stage is done as for primary anastomosis. The lower esophageal segment is cut away from the trachea at the site of the fistula, both ends are tied, and the chest wall is closed. Two or three days later a gastrostomy is performed. The third stage, performed one or two days after the gastrostomy, consists of bringing the upper end of the esophagus out in the neck, so the patient can swallow saliva and is no longer in danger of aspiration pneumonia. After an indefinite period an anterothoracic esophagus is constructed, later uniting the skin tube to a jejunal segment.

Since January, 1939, 82 patients with esophageal atresia have been seen at the Children's Hospital of whom 76 have been operated upon by Ladd, Gross and Swenson. Experience has greatly reduced the mortality in these cases, but there undoubtedly will continue to be an appreciable mortality due to associated anomalies incompatible with life.

Sweet, Richard H.: Pulsion Diverticulum of the Pharyngo-Esophageal Junction: Technic of the One Stage Operation; A Preliminary Report. *Ann Surg. 125:* 41, Jan. 1947.

For many years, as pointed out by Sweet, there has been a division of opinion among surgeons concerning the technic to be used in the operation for excision of diverticula of the pharyngo-esophageal junction. Early one-stage attempts led to discouragement as a result of the frequent occurrence of deep cervical or mediastinal infections and the development of fistulas. The two-stage procedure was developed to avoid these complications.

A review of the technical details of the earlier one-stage methods suggests the reasons for failure. Careful handling of tissue, sharp dissection, preservation of maximum blood supply, carefully placed sutures tied without tension for each layer, and the postoperative use of chemotherapeutic and antibiotic agents greatly aid in the prevention of complications.

Sweet has performed the operation in 5 cases with complete freedom from complications of any sort, the average postoperative hospitalization being 11 days.

HAND

Einarsson, F.: On the Treatment of Dupuytren's Contracture. *Acta chir. Scandinav. 93:* 1, 1946.

Einarssen points out that the pathological change in Dupytren's contracture is in the palmar aponeurosis, where increased vascularization and round-cell infiltration in proliferating connective tissue give way in time to a tendon-like cord, and gradual contracture of this cord causes severe flexion deformity of the fingers, normally on the ulnar side of the hand. Deep extension of the process may surround the vessels and nerves, but the flexor tendons themselves are never included in the pathological process. Subcutaneous fat and sometimes palmar skin degenerate into fibrous tissue.

Many surgical procedures have been advanced to offer relief to the patients. All are directed toward excision of all or part of the palmar aponeurosis, division of the palmar aponeurosis or digital amputation. Incision should as nearly as possible follow the palmar creases. Great care must be taken to avoid injury to embedded vessels and nerves, which may be widely displaced.

Prognosis must be guarded as to recurrence, which is frequent, and tender or insensitive fingers may be a handicap in the absence of recurrence.

During 16 years 164 hands were treated for Dupuytren's contracture at the Orthopedic Hospital. The surgery was partial excision of the palmar aponeurosis and/or digital amputation. There is an increasing tendency toward wide excision rather than simple section of contracting bands. Only 7 patients required skin grafting.

A follow up of 63 hands for 6 months to 12 years showed 69 per cent excellent results, 11 per cent fair results, and 20 per cent poor results.

Indications for operation are—

rhinoplastic procedures are usually due to excision of vestibular lining and exposure of raw surfaces. Postoperative endonasal adhesions cause severe interference with breathing as well as retraction of tip cartilages. To prevent this the vestibular skin should not be removed, and all endonasal incisions should be thoroughly closed.

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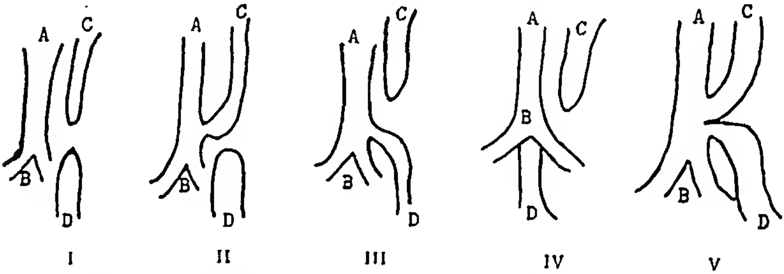

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Indications for operation are—

(1) Mild cases in early life when excision of the palmar aponeurosis of the ulnar three fingers is prophylactic against the sure, slow progression of the disease.

(2) Severe cases in mature life if the patient is handicapped by the deformity and gives reasonable promise of ability to heal a surgical wound.

Shaw, Darrel T., and Payne, Robert L.: One Stage Tubed Abdominal Flaps. *Surg. Gynec. Obst. 83:* 205, Aug. 1946.

The open pedicle flap, as stated by Shaw and Payne, has the disadvantage of a contaminated wound requiring secondary closure. Any open wound of the hand impairs the return of function. It is therefore considered desirable by the authors to convert the donor area and base of the pedicle into a closed wound. The donor site may be sutured primarily or covered by a split-thickness skin graft. A one-stage tube closes the base of the pedicle as well as the donor site and is very useful for covering irregular defects of the hand.

As described by Shaw and Payne, the flap is outlined on the abdomen as two parallel incisions tapering to a blunt point superiorly. It is raised either just superficial to Scarpa's fascia or including that fascia. The attachment of the flap is extensively undermined to allow mobility in closing the angles. The donor defect is closed with continuous subcuticular stainless steel wire. By staggering the inferior ends of the incisions the base of the tube may be rotated through an arc of 180 degrees. The flap is formed into a tube by simple interrupted sutures and is applied to the recipient defect by subcuticular sutures of fine white nylon and interrupted skin sutures.

If the original defect is completely covered at the time of application the tube is divided in about 3 weeks. If the tube itself is used to cover a part of the defect, a longer period of time is allowed and a delay is used.

TUMORS

Beerman, Herman: Tumors of the Skin. Part II. A Review of the Recent Literature. *Am. J. M. Sc. 212:* 497, Oct. 1946.

A comprehensive review of the recent literature on tumors of the skin with an extensive bibliography is presented by Beerman.

Epitheliomas (cutaneous carcinomas) are divided into basal-cell and prickle-cell or squamous-cell or epidermoid carcinomas. Basal-cell epitheliomas vary in size from small to large, are chronic, with a slowly growing superficial to deep nodule or ulcer and a rolled pearly, telangiectatic border. The centre of the lesion is usually covered with a crust, removal of which causes bleeding. This epithelioma occurs predominantly on the face and forehead but may appear elsewhere. Histologically, arrangement of the strands varies, being like a lattice network, having a glandular arrangement, or a solid growth of basal cells arising from the basal cells of the epidermis, rarely from the basal cells of the dermal appendages. Basal-cell epitheliomas do not metastasize but are destructive locally. Those which metastasize are generally basal-squamous or squamous cell. Pigmented basal-cell cancers may occur. They may resemble pigmented nevi or melanomas, but they are firmer and more indurated than pigmented nevi and more brownish than bluish in color. Treatment of basal-cell epitheliomas is by excision, electrodestruction or radiation, depending on the size and location of the lesion.

Prickle-cell or squamous-cell carcinoma presents a wider and more indurated border than basal-cell epithelioma. Senile keratoses are frequently forerunners of this type of lesion. They may resemble gumma if situated on the lip or tongue. They have a tendency to metastasize, particularly Broder's grade 3 and 4. Treatment should be radical.

Calcifying epithelioma is a hard spherical tumor located under the derma and fixed to the skin but movable over the deeper tissues. It occurs on the head, arms, forearms and back, then elsewhere, at any age but often in youth or early adult life. The lesion is encapsulated with a dense fibrous stroma containing giant cells. It is a local growth and is cured by local excision. Opinion differs as to the origin of this tumor. It has been variously regarded as endothelioma, or atheroma, a basal-cell derivative of an epithelial rest, cholesterotoma or dermoid cyst.

Multiple superficial epitheliomatosis may

be dry or eczematoid in type. The lesions first appear on the trunk as erythematous, smooth, flat, irregular shiny macules, which gradually become enlarged and coalesce to form plaques, 2 or 3 cm. in diameter. The course is benign, and metastasis is rare, though local recurrences are frequent.

Metastatic cutaneous malignancy: Carcinoma of the breast produces as many secondary skin tumors as all the other types together. Next in order of frequency of involvement, is the stomach, then the uterus, lung, large intestines, kidney and ovary, esophagus, liver, *et cetera*. The importance of metastatic lesions in the skin is that they are often the first evidence of the existence of malignancy. They have a predilection for certain sites, especially the chest, axilla, abdomen, and perigenital region, the scalp being rarely involved.

Cutaneous carcinoma arising from various cutaneous disorders: Among the cutaneous diseases secondarily involved by carcinoma are: Xeroderma pigmentosum, rhinophyma, Darier's disease, sebaceous cyst, psoriasis, lupus vulgaris (0.5 to 1 per cent of cases), radiodermatitis, lupus erythematosus, granuloma inguinale and lymphogranuloma venereum. The mechanism of the carcinomatous change in most of these conditions is not clearly understood. Trauma, arsenic medication, and exposure to irradiation (the sun, and roentgen rays) are among the proposed causes.

Malignant melanoma: Beerman does not give details of the controversy over the origin, epidermal or mesodermal, of these tumors but expresses the conviction that they are probably of epidermal origin. Malignant melanoma is essentially a disease of the white race, appearing more frequently in males. The lesions may occur at various ages but the average appearance is at about 50 years. They are located on any part of the body but most frequently on the extremities and exposed parts. A rare location is the nail-bed or nail-fold. The process usually begins as a solitary blue-black or steel-blue flat or elevated nodule, plaque or tumor of several millimeters to several centimeters in diameter. Occasionally the color may be a lighter brown, especially when a pigmented nevus undergoes malignant change.

It is stated that one-third to two-thirds of the malignant melanomas arise from a pigmented nevus, but there is disagreement as to the type of nevus which is the precursor of this particular lesion.

The author states that while Montgomery claims they may arise from both the superficial flat or junction type of nevus and the ordinary hairy mole, he believes this must occur very rarely. The first symptom of malignancy is a very rapid increase in size, and the lesion may become verrucous, fungoid or ulcerative, the pigment increasing about the same time. Metastasis may take place early in the disease and may skip adjacent lymph nodes to involve inner organs. Multiple cutaneous metastases may be pigmented or not. Those from the eye are usually amelanotic.

Most authorities agree that electrocoagulation or cauterization is dangerous, and that use of radiation therapy is to be discouraged. Radical excision is advised, with amputation when necessary. Dissection of the regional nodes should be done.

Beerman continues with a discussion of connective-tissue tumors, nevi, leiomyoma, myoblastoma and glomus tumor. A classification of the various types of nevi by Traub is given in detail.

Muller, William H. Jr., and Harkins, Henry N.: Malignant Soft Tissue Tumors of the Lower Extremities; A Radical-Conservative Technique of Wide Excision and Skin Grafting without Amputation. *Surgery 21: 245*, Feb. 1947.

A procedure in which free skin grafts are applied immediately after wide local excision of sarcoma of the soft tissues of the lower extremity is described by Muller and Harkins in a report of 5 cases in which the patients were treated in this manner at Johns Hopkins Hospital. An analysis of 22 cases of sarcoma of this type in which the patients were under treatment from 1935 to 1945 is included in this report.

The technic is called "radical-conservative" by the authors: radical, because such an extensive excision is done that large skin grafts are necessary; conservative, because amputation is not performed. This method may be used in all cases in which conservative local excision is contemplated or when amputation is refused.

In accordance with the technic described, the neoplasm is excised so as to include as wide a margin of normal tissue as the anatomic position of the lesion will permit. The incision extends through the subcutaneous tissue and fascia, the latter being especially widely excised since it is believed that sarcoma extends by way of the fascia. Where muscle tissue is involved, the muscle is ablated down to the underlying bone. If such structures as the sciatic nerve or great vessels are intimately involved, amputation is indicated. The area of excised tissue may be covered with dermatome grafts at any time thereafter, but the optimal time, according to the authors, is at the time when the initial procedure is carried out.

One of the cases described required 5 split-thickness dermatome grafts to cover the exposed area. One patient developed a recurrence, and the leg was amputated 11 months after the "radical-conservative" operation. In the remaining cases, the follow-up period extended from 3 to 24 months without recurrence.

MISCELLANEA

Gordon, R. A.: Anaesthesia for Plastic Surgery. *Canad. M. A. J. 56:* 277 Mar. 1947.

The handling of the special problem associated with plastic surgical practice is described by Gordon from the viewpoint of an anesthetist. Endotracheal anesthesia is the technic of choice for procedures about the head and neck. He advises the induction of a small intravenous dose of a short-acting barbiturate for all patients. This is usually followed by an inhalation anesthesia until relaxation has been obtained, and this in turn is followed by intubation.

When intubation is completed the pharynx is packed with fine mesh gauze, which is impregnated with paraffin oil or vaseline. This is used in preference to any type of pneumatic cuff on the endotracheal tube. The decision for nasal or oral intubation is dictated by the sight and nature of the operation. In some patients, the routine procedures are either difficult or impossible. These patients may be handled by anesthetizing them to a point of complete relaxation by the intravenous route and then passing the endotracheal tube. The catheter adapter and connecting tube of the anesthetic system, if they intrude themselves into the operative field, should be sterilized first.

Concerning the use of epinephrine, Gordon has not seen any patients with ill-effects from the injection of a solution containing epinephrine about the operative field to promote hemostasis. Rarely was more than 6 to 8 c.c. of this solution injected, in a concentration of from 1:120,000 down to 1:60,000. The drug was employed when cyclopropane was being used as the anesthetic. The practice of applying packs, soaked in epinephrine solution to vascular areas in order to produce hemostasis, is condemned, however. Nerve block anesthesia is recommended as being useful in plastic surgery on the extremities.

Mason, Michael L.: The Surgical Management of Irradiation Injuries. *Quart. Bull. Northwest. Univ. Med. School, 21:* 45, 1947.

Mason advises complete excision of the diseased area and plastic covering of the resultant defect as essential to the successful surgical management of irradiation injuries, but it is not always possible to determine the extent of the lesion. He attributes this difficulty to the slow progression of the pathologic changes in the skin and underlying tissues, years elapsing in some cases before the full extent becomes known.

Chronic irradiation dermatitis is still frequently seen in physicians, roentgenologists, dentists and technicians following the cumulative effect of repeated small doses of x-ray radiation. The author describes three ways in which the dermatitis commonly occurs:

(1) A massive single exposure such as may accompany a prolonged fluoroscopic examination, or an accidental overexposure may give rise to an acute dermatitis.

(2) Therapeutic irradiation for skin lesions usually of a benign nature such as ringworm, warts, eczematoid dermatitis and pruritus ani may be followed by a dermatitis more serious than the original condition.

(3) The port of bombardment of deep x-ray therapy, as for lymph glands, deep structures of the neck or pelvic malignant lesions, may break down several years later and a chronic ulcer develop.

The essential pathologic lesion seems to be an obliterative endarteritis which causes a nutritional disturbance leading to formation of areas of necrosis in the corium and a reparative proliferation, which may lead eventually to malignant changes.

In the management of the dermatitis the surgeon must contend with the faulty circulation and the ever-present infection deep in the skin and subcutaneous tissues which interfere with the healing of the free grafts or flaps.

Green, John R.: Repairing Bone Defects in Cranium and Tibia. *South. M. J.* *40:* 289, Apr. 1947.

To Green, fat appears to be a good material for repairing defects in bone because it is the least differentiated of all mesenchymal tissue and is used by nature to fill cavities in the body. He concludes that fat changes readily to fibrous tissue, and the latter may be transformed to bone. Two cases are described in which free fat transplants were successfully used in repairing a long-standing cranial defect and in filling a large defect in the lower end of the tibia.

The fat is obtained from the upper gluteal region, the underlying muscle sheath being taken along with it, and a thin layer of fat being left attached to the skin. About one-fourth more than the required is taken to allow for shrinkage through liquefaction. At no point in the technic is the fat touched by the surgeon's hands.

In the repair of the tibial defect, the fat graft was laid in the defect and held in place by many strands of stainless steel wires encircling the ankle and passing over the surface of the exposed fat. Topical applications of plasma, calcium sulfate and normal saline were continued daily. Twenty-six days later a full-thickness skin graft was applied over the surface.

The use of penicillin, calcium sulfate and normal saline, according to Green, appears to cause rapid transformation of fat into a solid substance. He believes that penicillin is especially beneficial in such cases, because it follows the pattern of reacting favorably on mesodermal structures while being destructive to ectoderm- and endoderm-derived tissues.

Baxter, Hamilton, and Moore, Robert H.: The Effect of the Local Reduction of Temperature on Scald Burns in the Rat. *Am. Surg.* *125:* 177, Feb. 1947.

It has been reported recently that hypothermic therapy was beneficial in the treatment of acute burns, but this conclusion was based only upon clinical impressions of but 3 published cases. Experimentally, Baxter and Moore have studied the effects of prolonged local cooling on the healing of thermal burns in 206 rats. In this carefully controlled series of experiments 13 cm. of the tail of each rat was subjected to a "standard burn"—immersion in water at 100 degrees C. for 3 seconds. Subsequent refrigeration of the burned tails was carried out in a special low temperature chamber.

Baxter and Moore observed that prolonged cooling of only a moderate degree induced vasodilatation which was present during the cooling period and which persisted later in normal environmental temperatures. However, the results of these experiments indicate that hypothermia is definitely harmful in the treatment of experimental burns. The damaging effects of refrigeration became apparent when the burned tails were allowed to survive for some time at room temperature, gangrene being more pronounced in those tails which had received the most refrigeration. These harmful effects may have been the result of the clumping of red cells and obstruction of the dilated vessels observed in both burned and unburned tails which had been cooled, or the persistent edema in the restricted anatomical structure of the rat's tail. It was concluded that the use of cold may be satisfactory in preserving recently ischemic tissues, but there is insufficient evidence that it is beneficial in the healing of fresh burns.

In accordance with the technic described, the neoplasm is excised so as to include as wide a margin of normal tissue as the anatomic position of the lesion will permit. The incision extends through the subcutaneous tissue and fascia, the latter being especially widely excised since it is believed that sarcoma extends by way of the fascia. Where muscle tissue is involved, the muscle is ablated down to the underlying bone. If such structures as the sciatic nerve or great vessels are intimately involved, amputation is indicated. The area of excised tissue may be covered with dermatome grafts at any time thereafter, but the optimal time, according to the authors, is at the time when the initial procedure is carried out.

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